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CONTROL OF CASEOUS LYMPHADENITIS IN SHEEP.

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MANY of our sheep-farmers will be familiar with a condition met with in sheep—more commonly in Merinos and half-breds—known as caseous lymphadenitis, and characterized by lesions simulating abscess formation found in various lymphatic glands of the body. Lymphatic glands are round or oval bodies varying in size, interposed in the course of the lymphatic vessels, and through which the lymph passes in its course to be discharged into the blood-vessels.

In lambs and adult sheep the commonest lymphatic gland found affected with caseous lymphadenitis is the prescapular, situated at the base of the neck just above the point of the shoulder. The next commonest gland affected in adult sheep is the precrural, situated in the thin flank. In lambs the second commonest gland affected is the popliteal, situated in a pad of fat deep in the muscular tissue at the back of the leg between the hock and the stifle (this gland is generally seen and incised when carving a leg of lamb); the gland is also affected in adult sheep. Other lymphatic glands affected are the supra-mammary in the female, situated above the posterior margin of the base of the udder; the corresponding gland in the male, the superficial inguinal, is also affected. More rarely lesions are found in various internal lymphatic glands.

When affected with the disease the lymphatic gland becomes enlarged to a varying degree; the lesion in the gland consists of localized inflammation, followed by a suppuration with nodule formation, a capsule surrounding the nodules. The contents of this suppurating nodule consist of a greenish-coloured pus, which, when the condition has been in existence for some time, becomes converted into a cheesy looking material. The lesion is produced by infection with a specific bacterial organism, *Corynebacterium pseudotuberculosis* (Preisz Nocard bacillus), which was first described in France in 1891. This organism is relatively resistant to drying, and under certain conditions it may remain viable for many months, but it can easily be destroyed by disinfectants.

The common method of infection is definitely through the inoculation of wounds or abrasions of the skin, such as occur in the operations of shearing, castration, docking, crutching, &c. This view is supported by work carried out at the Wallaceville Veterinary Laboratory, where more or less typical lesions have been set up by the experimental inoculation of skin wounds, and by shearing sheep with shears upon which pus from ruptured abscesses had been smeared. Further work to ascertain other possible methods of infection have all ended in failure—namely, infection by means of the sheep ked, by drenching sheep with pus and cultures of the organism over prolonged periods, and by running lambs on affected sheep in the attempt to affect lambs.

Caseous lymphadenitis is known to occur in parts of Europe, the United States of America, Argentina, Australia, and New Zealand. The incidence of the disease in New Zealand is fortunately very much lower than in either the Argentine or Australia. The percentage found in all adult sheep slaughtered in this country is only 1.54, and in lambs slaughtered 0.096. The figure shown for the lambs may be considerably modified in that the majority of cases found with abscesses present as a result of castration have been shown to be affected with other organisms than the Preisz Nocard bacillus. Nevertheless, it is obvious that every effort should be made to prevent any possible increase, and also still further to reduce the present incidence.

The disease is of considerable economic importance because no mutton or lamb carcasses found affected may be exported from the Dominion; consequently in the meat-export slaughterhouses a good deal of time is expended by the inspection staff of the Live-stock Division in detecting affected carcasses.

In the circumstances mentioned, it is hardly necessary to emphasize the importance of methods of control being evolved that appear to be satisfactory and at the same time capable of efficient application in practice. The possibility of control measures has been engaging the attention of the Live-stock Division for some time past, and definite work has been in progress during the past two seasons on the methods to be described.

It has been realized that the main concentration of infective material is most likely to take place in the shearing-shed and its immediate neighbourhood, where sheep have congregated, often in very large numbers, probably for some years past. Quite a number of abscesses are opened during shearing, and the discharge contaminates the wool, which may also be similarly contaminated by the discharge from abscesses ruptured some time previously. It can readily be understood that in shearing such sheep the shears passing through the contaminated wool will carry away sufficient material to infect other parts of the same animal or the following sheep, and that a ruptured abscess on a sheep moving about among its shorn fellows in the yards may infect many cuts which escaped such infection with the shears.

This knowledge suggested the early detection of all affected sheep and their strict isolation, so that they can be crutched and shorn after the main operations have been completed. Thorough disinfection, in addition, is essential.

DETECTION OF AFFECTED SHEEP BY PALPATION.

The lymphatic glands mentioned in the introduction can be palpated by hand and any enlargement detected; this is especially easy in sheep not carrying too much wool and condition. The best way to carry out such an examination efficiently on a large number of sheep, is to put them through the shearing-shed, up-end them, and examine each sheep carefully in the manner shown in the accompanying photographs, showing palpation of the prescapular, precrural, popliteal, and supra-mammary or superficial inguinal glands respectively. Naturally a certain amount of instruction and demonstration on live sheep and also carcasses will be necessary before farmers can become quite competent to undertake the examination for themselves. Afterwards a certain amount of work is involved, but there is no very great difficulty in the procedure.

Some convenient muster can be selected for the purpose of palpation; it may not be possible to do all sheep at shearing-time, owing to difficulty in holding the sheep in the vicinity of the shearing-shed any undue length of time at that period of the year. In the case to be illustrated the wethers were examined at the dipping muster, and the ewe flock at the autumn muster. A ewe flock was examined at the beginning of May, 1931 (by C.V.D.), with the following results:—

Table 1.

Number of Sheep examined.	Age.	Number found affected.	Percentage.
3,753 ..	Two-tooths	38	1.01
2,976 ..	Two years rising three ..	219	7.36
2,531 ..	Three years rising four ..	346	13.67
1,936 ..	Four years rising five ..	443	22.88
11,196 ..	.. ..	1,046	9.34

The above table gives a good indication of the increased incidence of the disease with rising age. This is a generally acknowledged fact, due to more frequent exposure to infection at successive shearings, crutchings, &c. It will be noted that no figures are shown for lambs, as the whole of the lambs were not examined, owing to the known low incidence in unshorn lambs. However, 3,046 lambs were carefully examined after slaughter at the freezing-works in 1931, and 1,781 in 1932, without the detection of a single lesion.

The following precautions were taken after the 1931 examination: (1) The whole of the affected ewes, numbering 1,046, were specially branded and kept entirely separate from the main flock; (2) at shearing No. 2 combs were used on all sheep for the first time; by this method the number of cuts and abrasions was considerably reduced; (3) the affected ewes were crutched and shorn by themselves after the main operations; (4) the machine-heads were dismantled and carefully disinfected after crutching and shearing the affected flock; (5) during crutching and shearing special attention was paid to the dressing of cuts, though in machine-shorn sheep it is found that there are a number of very small wounds in which the skin is only just broken,



FIG. 1. SHOWING METHOD OF PALPATION OF THE PRESCAPULAR GLANDS.

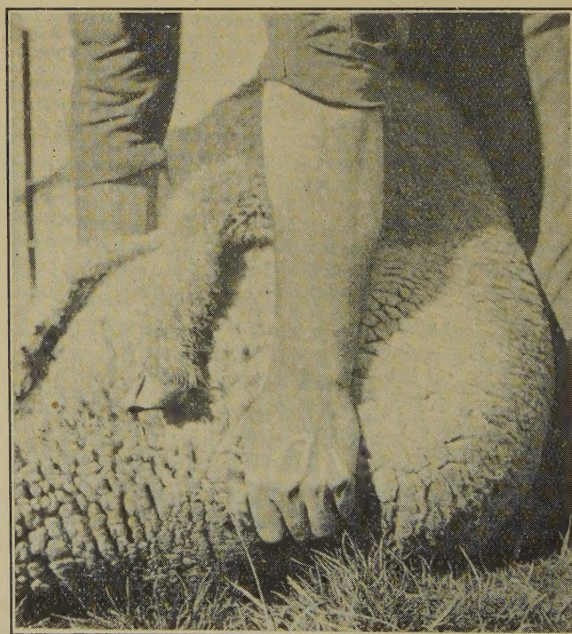


FIG. 2. PALPATION OF THE PRECRURAL GLANDS.

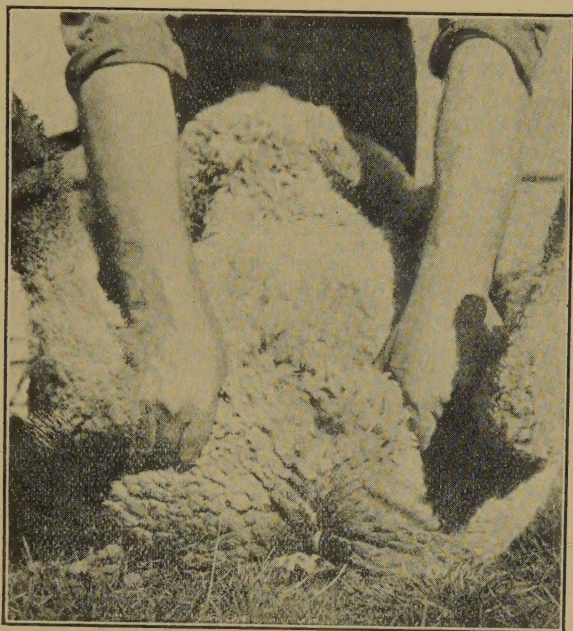


FIG. 3. PALPATION OF THE POPLITEAL GLANDS.

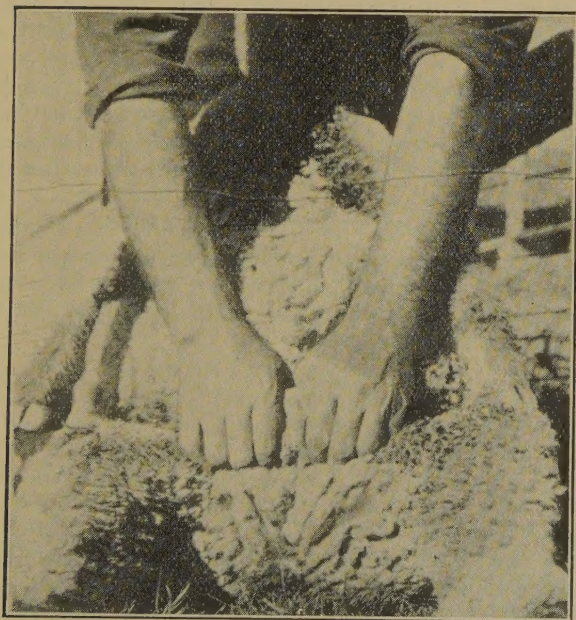


FIG. 4. PALPATION OF THE SUPRA-MAMMARY OR THE SUPERFICIAL INGUINAL GLANDS, AS THE CASE MAY BE.

many of these not being noticed and escaping being dressed; (6) the shearing board was disinfected before and after shearing, and the ground of holding-yards, &c., was cleaned up and dressed with quicklime.

The main ewe flock was again examined at the beginning of May, 1932, with the following results:—

Table 2.

Number of Sheep examined.	Age.	Number found affected.	Percentage.
2,121 ..	Two-tooth	10	0.47
3,450 ..	Two years rising three ..	81	2.34
2,810 ..	Three years rising four ..	161	5.72
1,748 ..	Four years rising five ..	125	7.15
10,129 ..	..	377	3.72

The results of this examination were looked forward to with very great interest, as it was obvious that if the work was to be justified the incidence must show a marked decline in the first year. The total percentage of affected sheep has declined from 9.34 to 3.72, which is considered particularly satisfactory for the second examination only. In addition the lesions found in the affected sheep were generally smaller than those found in 1931, also there were fewer sheep with more than one gland affected. The affected sheep have been segregated, and the examination will be repeated again next year, after the usual precautions have been observed in the meantime. The figures for the wethers are not shown, as they were only examined for the first time in 1932.

Of the 1,046 sheep segregated in 1931 the 443 five-year-olds were disposed of, but 575 of the remainder were re-examined in 1932. Of these, 317 were still noticeably affected, five showed open lesions, and six showed recent scars; but in 258 no lesions were then noticeable.

PALPATION IN DRAFTING-YARDS.

As an alternative method to up-ending sheep, one of us (C.S.M.H.) tried the following means of palpation on 16,000 ewes on a station where caseous lymphadenitis was not particularly bad but sufficient in extent to inconvenience the owner:—

Sheep are run into classing-yards, 5 ft. by any convenient length, such being common in most well-designed sheep-yards. These yards open into the diamond, and thence through the drafting race. The classing-yards are filled two-thirds full, thus holding about forty sheep. Sheep should be run in just before palpating commences, otherwise they tend to turn round and make it much more difficult for those working. Two men side by side then commence from the back of the sheep feeling for enlarged glands, running their hands over the shoulder and gripping deeply beneath the muscle over the point of the shoulder, then passing on to the loose flank in front of the hind legs, and finally feeling the udder for any swelling. In older ewes the udder is a very common position for abscesses to be found in, and any hard lump deep in the tissue or discharging to the surface should cause

the sheep to be culled. A raddle mark can be used to draft the sheep out at the race. As one pen is finished the two operators climb over the dividing-fence between the two pens and commence on the second pen. Meanwhile the first pen is refilled by the shepherd in charge. A tally of the sheep run through is kept at the race. The number actually palpated per day depends largely on the following conditions :—

(1) The state of the sheep; for example, wet weather makes the sheep difficult to move and hard to handle, and in any case the work is most uncomfortable in wet yards and heavy coats. Dry sheep run well, and younger sheep run better but fight more than old ones. The length of wool is also a very great factor.

(2) The state of the hands of the workers and their bodily fitness is probably the greatest limiting factor in the work. Constant use of the fingers makes the hands swell, and after a number of hours the work is not nearly as exact as at the commencement of the day.

(3) The arrangements for bringing in sheep and getting rid of them following palpation also limit the numbers put through. Very few large sheep-owners could bring in the sheep for the one class of work only, and one therefore has to decide on a time suitable for the farmer for palpation. It is much simpler to do sheep without wool than in full wool; therefore directly after shearing would naturally be the easiest time. But there is so much to be done at shearing-time that this is not practicable in many instances; also there arises the question of whether it would not be directly detrimental to bring sheep into closer quarters than is necessary after shearing, when there are many ruptured abscesses to be seen, and many fresh cuts ready for infection when a sheep smeared with pus pushes along among its neighbours in a close yard. Weaning-time or classing-time then suggest themselves, and as sheep have then been shorn some two or three months and wool is not very long such times suggest themselves as being best from all points of view. In the autumn only the breeding-ewes are left on the place as a rule, except possibly a few wethers, and as these ewes are classed for putting to the rams as regards age, conformation, wool, condition, &c., it is easy to apply then the palpation method for caseous lymphadenitis.

The result of the palpation of the flock last referred to was as follows :—

Table 3.

Number of Ewes examined.	Total.	Number affected.	Percentage.
Four-tooth	3,657	16	0·44
Six-tooth	3,999	104	2·60
Four-years	5,770	250	4·33
Five-years	2,818	169	6·00
	16,244	539	3·32

It was considered unnecessary to put through the seven thousand two-tooths on this particular station. A further palpation will be carried out in the 1933 autumn to find whether this method can compare favourably with the up-ending method. The affected sheep, 539 in number, have been segregated and mated with rams as a separate flock.

SOME OTHER OBSERVATIONS.

At Wallaceville eight ewes with abscesses easily palpable were kept two years and examined each fortnight. Two of the ewes had enlarged glands which failed to rupture; one was lanced and developed large numbers of internal abscesses, probably as a result of the surgical interference; the remaining five when killed appeared perfectly clean, and the once affected glands were practically normal. The question therefore arises as to the absolute necessity for getting rid of sheep which may later become normal. It is necessary to segregate while such ewes clean up, but if when abscesses have ruptured and cleaned up, the ewes are repalpated on two occasions at several month interval and found normal, then it would seem permissible to return such animals to the flock. However, most flock-owners would not care to take the risk entailed and would sooner slowly cull those sheep once found affected.

It is a noticeable fact that the left side glands are more commonly affected than the right, and this may possibly be explained by the fact that the shearer opens up the fleece from the left side, more or less on the blind as it were, and consequently makes more cuts and abrasions and any pus on the machine-head is left in the cuts. He is working the machine-head towards the body of the sheep instead of away from it, as is the case on the right side. The persistency of this fact is shown by the following data in connection with flocks examined:—

Table 4.

Examinations.		Number of Affected Glands.					
		Prescapular.		Precural.		Popliteal.	
		Right.	Left.	Right.	Left.	Right.	Left.
Ewe flock, 1931	..	171	198	224	261	1	4
Wether flock, 1932	..	48	77	56	77	9	14
Ewe flock, 1932	..	65	80	55	93	1	4
Totals	..	284	355	335	431	11	22

Besides palpation and segregation of the sheep annually, disinfection of shearing-machine combs or of blades is necessary for the first year or two at least. It is still a matter of trial as to which is the best disinfectant to use for the purpose, but it is hoped to be able shortly to incorporate a disinfectant into the oil used for lubricating the machine. The majority of watery solutions cannot penetrate the oil and lanolin covering the machines, so that a special method will have to be employed.

CONTROL METHODS SUMMARIZED.

Methods of control for caseous lymphadenitis in sheep have been indicated which are capable of practical application by all those owners of sheep concerned with the disease. Requirements are as follows:—

(1) Annual palpation of all sheep, two-tooth and upwards, with subsequent strict segregation of affected sheep.

(2) Affected sheep must not be exposed for sale except to meat-works.

(3) The affected sheep to be shorn and crutched separately, preferably at the conclusion of the main operations.

(4) If shearing is done by machines, No. 2 combs or thicker ought to be used. Blade shearing is very satisfactory, as it has previously been noted that the incidence of the disease is greater in machine-shorn flocks than in blade-shorn. More cuts and abrasions are made with machines than with blades.

(5) Where practicable sheep could be passed through a so-called "non-poisonous" dip off the shears.

(6) Thorough disinfection of blade shears and machine-heads after the shearing and crutching of the affected flock and before the commencement of the respective main operation is absolutely essential, also during shearing and crutching, especially when an abscess is met with. A systematic disinfection of the shearing-shed must be undertaken, and suitable treatment applied to the holding-yards, races, &c.

If the methods here advocated are systematically and thoroughly carried out each year, there appears no reason why caseous lymphadenitis in New Zealand should not be still further decreased, if not ultimately completely eradicated.

SOME ECONOMIC PHASES OF APPLE PRODUCTION IN NEW ZEALAND.

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At present apple production in New Zealand is rapidly expanding; hence a survey of its activities is fully warranted to enable one to see how the industry is developing, what difficulties are likely to be met, and how they can be overcome. It is anticipated that production will increase by 17 per cent. within the next five years, indicating that the already acute marketing problems will become even more difficult in the future. This study, embracing the whole of the Dominion, presents a picture which may be of value to producers. The results presented are based on the production season of 1930-31, and are a fuller continuation of the investigation instituted the previous year, 1929-30.

Of the 1,370 questionnaires posted, 870 were returned, of which 719 were used, while the balance of 151 had to be deleted because of incompleteness or unsuitable data. The reliance that may be placed in the results is evident when one considers that of the total orchards having over 300 apple-trees producing fruit for sale, half are included in this study, while the number of trees represented is 44.4 per cent. of all apple-trees of orchards producing for sale.

Over 130 varieties were listed on the questionnaires returned. As a number of varieties have more than one name, it has been necessary to introduce uniformity in this respect. The names adopted, together with the alternatives in parentheses, are as follows: Cleopatra (New York Pippin), Desert Gold (Golden Delicious), Dunn's (Munroe's, Ohinemuri), London Pippin (Five Crown Pippin).

The data have been grouped into the following districts: North Auckland, Waitemata, Thames, Waikato, Gisborne, Hawke's Bay, Wairarapa, Manawatu, Nelson, Mapua-Tasman, Motueka, Marlborough, Christchurch, Southern Coastal, Tuapeka, Vincent. These names, with the exception of two, are self explanatory. The boundary between Rodney and Waitemata Counties is the boundary between North Auckland and Waitemata. Southern Coastal stretches from the northern boundary of Ashburton County to the southern boundary of Waitaki County, showing it to be a very extensive district. The districts chosen are apple-growing centres, and as such represent units in which the conditions operating between orchards are as constant as it is possible to make them in an analysis of this nature.

TOTAL PRODUCTION.

The contribution of individual districts to total production is a matter of some importance, particularly when considered in conjunction with the quantity exported from each. Table 1 is based on the total number of apple-trees in orchards producing fruit for sale as ascertained at 21st June, 1930, which, with the quantities exported, has been obtained from the Horticulture Division of the Department.

Table 1.—*Estimated Total Production of Orchards producing Fruit for Sale and Total Export in 1930-31.*

District.	Estimated Total Production.	Export.	Percentage exported.
	Bushels.	Bushels.	
North Auckland	128,000	38,100	30
Waitemata	399,000	73,700	18
Thames	23,000	..	..
Waikato	24,000	3,800	16
Gisborne	84,000	17,300	21
Hawke's Bay	584,000	188,600	32
Wairarapa	72,000	17,200	24
Manawatu	18,000	400	2
Nelson	300,000	200,100	67
Mapua-Tasman	448,000	303,600	68
Motueka	434,000	285,400	66
Marlborough	90,000	57,700	64
Christchurch	277,000	28,000	10
Southern Coastal	43,000	600	1
Tuapeka	183,000	70,600	39
Vincent	52,000	7,800	15
Dominion	3,159,000	1,292,900	41

The results shown in this table will be of great value in forecasting, as it will be possible to gauge not only the relative changes in production, but also the actual quantity a crop is expected to alter by, thus assisting growers to allocate quantities for shipment overseas in accordance with anticipated local requirements.

It will be shown later that there is considerable variation in tree yields between seasons. For example, in Waitemata the average production per tree for 1930-31 increased 30 per cent. over the previous year, while in Hawke's Bay it fell by 18 per cent. This must affect the local production of a district, and hence, while the results shown in

this table represent the position as it appeared in 1930-31 and give a rough idea of the present relative position of each district, the normal total production will probably differ from the results shown. Nevertheless, this seasonal fluctuation will not affect the value for forecasting; on the contrary, it is essential to know the variation.

FUTURE PRODUCTION.

It has been possible to predict what the approximate movement in production will be in the course of the next five years. This has been possible through being able to calculate the proportion each age-group yields and by knowing the proportions of trees in the different age-groups. Thus, all predictions, being based on proportions, refer to normal yields, and take the normal yield of 1930-31 as the base.

Three reservations are necessary. Since these predictions refer only to normal yields, they cannot take into account seasonal fluctuations. Secondly, no consideration has been given to replacement. The replacement ratio in apple-trees is, precisely speaking, an unknown quantity, but whatever it is it must be small, for if the commercial life be from twenty-five to thirty-five years, then this ratio varies from 4.0 per cent. to 2.9 per cent. But as the majority of trees have not far passed, if reached, the level of maximum production, any trees cut out bear a very small percentage to the total. Lastly, any change in efficiency of management must necessarily result in a change in production, and as management conditions are more likely to improve than to retrogress these predictions are likely to be conservative.

The position with regard to future production is shown in Tables 2 and 3. The former shows individual districts, as it is estimated they will increase by 1935-36 compared to 1930-31. As it indicates the degree to which a district is anticipated to expand, it forms a valuable guide indicating to what extent it is necessary to provide for future

Table 2.—Anticipated Normal Increase in District Production in 1935-36 over 1930-31, and District Contribution to Total Increase in New Zealand.

District.				Estimated Increase within District.	Contribution to Dominion Total Increase.
				Per Cent.	Per Cent.
North Auckland	..	..	..	17	4
Waitemata	..	..	..	31	18
Thames	..	..	..	29	1
Waikato	..	..	..	57	3
Gisborne	..	..	..	43	4
Hawke's Bay	..	..	..	29	31
Wairarapa	..	..	..	9	2
Manawatu	..	..	..	15	1
Nelson	..	..	..	10	5
Mapua-Tasman	..	..	..	8	6
Motueka	..	..	..	11	7
Marlborough	..	..	..	5	1
Christchurch	..	..	..	11	6
Southern Coastal	..	..	..	15	2
Tuapeka	..	..	..	12	6
Vincent	..	..	..	11	3
Dominion increase				17	100

Table 3.—*Integrated Normal Production for Years 1931-32 to 1935-36 expressed as a Percentage of 1930-31.*

Year.			North Island.	South Island.	Total.
1930-31	..	..	100.0	100.0	100.0
1931-32	..	..	105.4	102.6	103.7
1932-33	..	..	110.9	105.1	107.4
1933-34	..	..	116.7	106.7	110.7
1934-35	..	..	122.5	108.6	114.1
1935-36	..	..	127.6	110.0	117.0

needs. The districts showing greatest proportional movement are Waikato and Gisborne, but the greatest movement in quantity is shown to be Nelson (including Morneka and Mapua-Tasman), Waitemata, and Hawke's Bay.

Table 3 affords an indication of what the relative movement in production will be in both Islands and in New Zealand as a whole up to 1935-36. In the North Island there will be an average annual increase of 5.5 per cent., aggregating to a total of 27.6 per cent.; the same for the South Island is 2.0 per cent. and 10.0 per cent.; while the New Zealand figure is 3.4 per cent. and 17.0 per cent. Further discussion on this phase is reserved till later.

FACTORS AFFECTING EXPORT.

There are two broad factors tending to determine the proportions of fruit exported from individual districts. They are size of district from the point of view of production, and proximity to local markets. These factors are interwoven one with another, one being of more importance in one district than in another. It must be noted that both factors operate in all districts, but the degree to which they operate varies considerably. They must not be interpreted literally, but attention must be given to what lies beneath.

Table 4.—*Districts arranged in Descending Order of Proportions exported, with Total Production of 1930-31 as an Indication of Size.*

District.				Proportion exported.	Total Production : Size of District.
				Per Cent.	Bushels.
Nelson	..	..	..	67	1,182,000
Marlborough	..	..	..	64	90,000*
Tuapeka	..	..	..	39	183,000
Hawke's Bay	..	..	..	32	584,000*
North Auckland	..	..	..	30	128,000
Wairarapa	..	..	..	24	72,000*
Gisborne	..	..	..	21	84,000
Waitemata	..	..	..	18	399,000*
Waikato	..	..	..	16	24,000*
Vincent	..	..	..	15	52,000
Christchurch	..	..	..	10	277,000*
Manawatu	..	..	..	2	18,000*
Southern Coastal	..	..	..	1	43,000
Thames	..	..	..	..	23,000

* Apparently anomalous.

Wellington's plentiful supply from Hawke's Bay and Nelson, suggesting a restricted demand for Wairarapa, are also factors affecting the position. Table 6 shows these districts and illustrates how size again becomes important. These are all small districts, and hence the desirable advantages secured in a large-sized district cannot operate here.

Proximity to extensive local markets operates powerfully against size of district. This is clearly noticed in Waitemata, where the proximity of Auckland undoubtedly has an influence, diverting what would be export to local requirement. The ease with which growers can associate with local middlemen, coupled with local demands, has an influence of far-reaching importance. Hawke's Bay and Christchurch, too, have the same factor operating, but in Tuapeka it would appear as though Dunedin's needs are more easily satisfied.

The following table shows these districts, and again illustrates how size becomes significant.

Table 7.—*Districts affected by Proximity of Local Market.*

District.					Proportion exported.	Total Production ; Size of District.
					Per Cent.	Bushels.
Hawke's Bay	..	..	..	..	32	584,000
Auckland	..	..	..	..	18	399,000
Christchurch	..	..	..	..	10	277,000
Manawatu	..	..	..	..	2	18,000

It is difficult to assign any predominating factor to Thames. It is quite possible that the small size of the district, together with its extensive character, coupled with the distance from Auckland, have been deterrents on export.

MARKETING OF THE INCREASE.

The significance of the increased production is evidenced in the following calculation. The crop for the year 1930-31 has been taken as an average crop, and district reports over the whole Dominion indicate that this is so.

1930-31	Production	..	..	..	..	..	Bushels. 3,159,000
	Export	..	..	..	..	..	1,293,000
	Balance for local consumption	..	..	..	..	..	1,866,000

Production, 1935-36 (117 per cent. of 1930-31)	..	..	..	..	..	Bushels. 3,696,000
Production, 1930-31	..	..	..	..	..	3,159,000

Surplus, 1935-36 over 1930-31	..	..	..	..	..	537,000
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Surplus as percentage of export 1930-31, 42 per cent.

Surplus as percentage of local consumption 1930-31, 29 per cent.

This means that the export facilities will have to bear an increase of 42 per cent. within the next five years if the surplus is to be entirely exported, while if none of the increase is exported the local market will have to absorb nearly one-third more than it did in 1930-31.

No emphasis is needed to stress the necessity for the organization of marketing both local and overseas. Because it is imperative to maintain and improve our prestige overseas by the best quality product, and because our increasing production necessitates export of the surplus, if New Zealand quantitative consumption remains constant, the quality of fruit remaining under existing conditions must tend to lower in quality. How can this lower quality be raised? A promising commencement has been made with the Dominion Mark scheme. That much fruit of exportable quality goes into local consumption can be deduced from a comparison of district proportions exported—Nelson as a whole exports 67 per cent., Hawke's Bay 32 per cent. It is a reasonable assumption, therefore, that the majority of the difference, 35 per cent., is of export standard but is absorbed by local demand. It is for this type of fruit that the Dominion Mark operates. But as time goes on this grade will probably be exported to prevent it exceeding the local demand, and thus fruit of a lower average quality must be marketed locally. Hence, if the quantity capable of finding a local sale as a graded product is not to be restricted, a grading scheme to cover this type appears imperative. An alternative is that the lower qualities be absorbed through factories for such commodities as dried apples, jam, or vinegar.

Continuing now to factors controlling export, it is clear that the productive size of the district is the most important. This, modified by local consumption, and in conjunction with proximity to exporting port and intensity, forms that very composite factor, efficiency of organization; but it is the quantity handled that determines the importance of the last. Hence, in the interests of the industry, maximization of export is a most desirable objective, as costs of export must then necessarily be reduced and innumerable advantages secured through large-scale operation, together with a smoother operation of the whole export machinery due to a greater degree of specialization in its many activities. One of the salient points here is the size of the orchard. The smaller the orchard the less is the tendency of the grower to export. Table 8, which shows the position in Waitemata, amply demonstrates this issue.

Table 8.—*Effect of Size of Orchard on Distribution as shown in Waitemata District.*

Range of Trees.			Number of Orchards.	Export.	Local.	Factory.	In Store.	Total.
				Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Under 499	..	..	15	13.8	76.7	..	9.5	100.0
500-749	..	..	27	12.5	68.5	2.8	16.2	100.0
750-999	..	..	22	18.2	72.4	5.3	4.1	100.0
1,000-1,249	..	..	20	22.6	58.3	4.2	14.9	100.0
1,250 and over	..	..	24	28.2	53.4	7.8	10.0	100.0

The anticipated increase in production should result in a more than proportional increase in export. In so far as the present facilities are capable, districts will benefit in lowered cost, but in so far as they are not capable of handling the increase the difficulties of the producer will be aggravated until relieved by better organization. To conclude, therefore, if the total surplus is to be exported, facilities will be

needed to handle an increase of approximately 42 per cent. by 1935-36, while there is a probability of the quality falling internally. On the other hand, if the total surplus is not all exported a reduction in internal prices appears inevitable, unless factories can absorb much of the lower grades.

COMPARATIVE ANNUAL YIELDS.

The principal function of Table 9 is to provide a basis of forecasting: its importance is to the industry as a whole, its merit being that it forms a basis which with the assistance of reliable estimates facilitates the prediction of a current season's crop.

Another phase of more importance to the individual orchardist is the use of the table as a gauge, indicating how his management is improving or retrogressing. To obtain this it is necessary to use the preceding year's yields—that is, it is based on two years' yields, the last year being expressed as a percentage of the first. This is open to the criticism that the age-constitution of trees is always changing

Table 9.—Average Yield per Tree in Bushels of all Trees of Bearing Age (Six Years old and over).

Variety.	North Auckland.	Waitemata.	Thames.	Waikato.	Gisborne.	Hawke's Bay.	Wairarapa.	Manawatu.
Sturmer ..	..	1.185*	..	2.090*	3.088*	3.753	1.615	0.802
Delicious ..	1.035	2.335	2.037*	1.400	5.415*	3.715	1.400	0.855
Jonathan ..	..	1.352	..	1.207*	..	2.759	0.837	..
Cox's Orange	..	1.269	..	..	..	2.959	1.684	..
Pippin	..	..	..	..	..	..	..	..
Dunn's ..	1.302*	2.830	..	..	..	3.826	1.276	..
Statesman ..	1.438	..	..	..	..	3.395	..	..
Granny Smith	2.000*	2.854	..	..	..	..	..	..
Gravenstein..	1.470*	1.330	..	0.340	..	3.149	..	..
Dougherty ..	1.882	1.527	..	..	..	3.931	..	..
Ballarat ..	..	2.825	..	..	7.346*	4.549	..	..
Other varieties	1.663	1.966	0.451*	1.636	..	4.622	3.251	1.098
All varieties	1.742	2.034	1.835	1.362	4.417	3.609	1.421	0.736

Variety.	Mapua-Tasman.	Motueka.	Nelson.	Marlborough.	Christchurch.	Southern Coastal.	Tuapeka.	Vincent.
Sturmer ..	2.101	2.434	2.365	2.148	1.736	1.537	1.718	0.607
Delicious ..	1.707	2.021	1.230	1.857	1.506	1.680	1.792	0.789
Jonathan ..	1.887	2.492	2.176	1.309	1.888	1.249	1.789	0.767
Cox's Orange	1.268	2.336	1.563	2.410*	0.805	..	0.751	0.882*
Pippin	..	..	..	..	..	..	..	..
Dunn's ..	1.618	2.102	1.866	2.425*	2.117	..	0.950	1.618*
Statesman ..	2.413	2.482*	2.575*	..	2.283*	0.879*	1.167	..
Granny Smith	2.233*	2.830*	..	..	..	..	..	..
Gravenstein..	1.618	..	..	..	..	..	..	..
Dougherty ..	1.850	2.549	1.336*	..	..	..	..	..
Ballarat ..	2.822*	..	..	5.028*	1.881*	1.420	1.380*	..
Other varieties	1.806	2.367	1.727	1.712	1.626	2.113	1.574	0.700
All varieties	1.807	2.351	1.951	1.750	1.700	1.305	1.340	0.602

* Under 1,000 trees in average.

and that therefore yields between different years are not strictly comparable. While this is true, it is contended that the difference between the age-constitution of two succeeding years is so small as to negative any shortcomings of this nature, and therefore the value of the information is by no means invalidated.

The data for 1929-30 were somewhat sparse, and the number of samples required was not so large as desirable; nevertheless, when presented, the results are of undisputed value to the grower. It is hoped that subsequent collections will not only remedy this, but also accumulate more material for deeper research and so enhance the value of the work generally.

A grower by taking his average yields for 1929-30 for those varieties shown in Table 10, dividing them into the average yield for 1930-31, and multiplying by 100 obtains a result which enables him to compare his progress in management with that of the other growers of his own district. If his result is lower than that shown in the table it would be advisable to seek the cause of the relative fall; on the other hand, if it is above it is a cause for personal satisfaction.

Table 10.—Comparative Annual Yields: Yield for 1930-31 expressed as a Percentage of 1929-30.

Variety.	Waitemata.	Hawke's Bay.	Nelson.	Mapua-Tasman.	Motueka.
Sturmer	..	95	106	105	102
Delicious	157	73	50	109	104
Jonathan	130	71	88	98	106
Cox's Orange Pippin ..	155	129	83	171	110
Dunn's	180	81	79	99	91
Statesman	..	71	76	132	98
Gravenstein	79	66	..	..	..
Dougherty	132	83	..	..	..
Ballarat	161	81	..	..	..
All varieties ..	130	82	87	107	101

It is the relative rise and fall between seasons that is compared, due consideration being given to the maturity factor. Another factor which has an important bearing in comparison of two succeeding seasons only is the biennial bearing habit of certain varieties. If a grower is endeavouring to improve his management he has no reliable guide as to what progress he is making because of seasonal fluctuations, a fact which is shown to have wide variation.

(To be continued.)

Botrytis Rot in Apples.—Mr. J. W. Whelan, Orchard Instructor, states that during the past fruit-export season botrytis rot was very much in evidence in the Wairarapa district. The disease was confined in two varieties, Cox's Orange and Jonathan, the latter being only slightly attacked. In Cox's Orange the disease was very prevalent, particularly so in those apples gathered at the first picking. During the latter part of the Cox's Orange season the disease had practically disappeared. The orchard in which the disease was most prevalent was heavily irrigated during the months of December and January.

COMMERCIAL FERTILIZERS AND THEIR BASIS OF SALE.

V. INORGANIC NITROGENOUS FERTILIZERS.

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1. Synthetic Nitrogen Products.

WITHIN the past ten or fifteen years the synthetic nitrogen industry engaged in the large-scale production of utilizable compounds from air nitrogen has made marvellous progress. Already the stage has been reached where it is producing at lower cost far more nitrogenous fertilizers annually than are produced from all other well known old-established sources such as Chilean nitrate deposits and the by-product ammonia plants of gasworks, &c., which in themselves are incapable of economically supplying modern international demands.

Quite apart from achievements in revolutionizing the production of standard nitrogenous fertilizers, this remarkably progressive industry has been responsible for introducing into commerce a great range of quick-acting combinations containing ratios of either one, two, or all three plant-foods—nitrogen, phosphoric acid, and potash—in double or treble the amounts contained in ordinary fertilizers. Throughout Europe, also in Asia, the United States of America, and certain tropical regions, very large quantities of the new synthetic materials are now either directly applied to the land or are used for raising and balancing the manurial content of factory-mixed fertilizers designed to suit special needs of crops and soils.

A number of synthetic brands carrying different formulas have appeared on the New Zealand market, and, although sufficiently large quantities have neither been sold nor experimented with to enable judgment to be passed on their performance, considerable interest has been evoked in their future opportunities and agricultural possibilities in comparison with the well-tried standard plant-food carriers. It has been claimed that, in consequence of having high proportions of beneficial nutrient matter in smaller volume, and the elimination of inert or low-grade constituents unessential to plants, such fertilizers are specially suitable for application in remote agricultural areas where high freight and distribution charges do not permit economical use of lower-grade fertilizing substances.

SIGNIFICANCE OF NITROGEN IN WORLD FERTILIZER PRODUCTION AND CONSUMPTION.

Before touching on the artificial conversion of atmospheric nitrogen into fertilizer, some indication of the very important position nitrogen from various sources has assumed in relation to modern agricultural and industrial needs is presented in Tables 1 and 2, data for which have been gathered from the most authoritative sources.

It will be seen that about 57 per cent. of the total production in terms of pure nitrogen comes from atmospheric sources, and of the total consumption of all fixed nitrogen,* including amounts from the two other

* The term fixed nitrogen denotes the direct chemical combination of nitrogen with other elements to form utilizable compounds. Farm-yard manure, fish, and other organic manures are natural sources of fixed nitrogen.

Table 1.—World Production and Consumption of Pure Nitrogen for Year ended 30th June, 1931.

Production :—

Sulphate of ammonia—		Tons.
Synthetic	.. .. .	435,000
By-product	.. .. .	417,620
		842,620
Cyanamide	.. .. .	259,560
Other forms of nitrogen—		
Nitrate of lime	.. .. .	128,400
Synthetic	.. .. .	420,430
By-product	.. .. .	50,570
Chile nitrate	.. .. .	456,540

Total 2,168,120*

Consumption :—

Manufactured nitrogen	.. .. .	1,561,402
Chile nitrate	.. .. .	358,045

Total 1,919,447*

Agricultural consumption included in total, about .. 1,722,000*

For the sake of illustrating what the total amounts of pure nitrogen would be in terms of solid nitrogenous compounds, the figures marked with an asterisk may be converted into equivalents of pure nitrate of soda on multiplication by 6.072, or pure sulphate of ammonia on multiplication by 4.715, with the following results :—

Equivalents.	Total Production. Tons.	Total Consumption. Tons.	Agricultural Consumption. Tons.
Nitrate of soda ..	13,164,825	11,654,880	10,455,980
Sulphate of ammonia	10,222,685	9,050,190	8,119,230

Of the total production, synthetic products amounted to 57.3 per cent., by-product to 21.6 per cent., and Chile nitrate to 21.1 per cent.

Table 2.—Estimated World Production of Fertilizers for Year 1928, showing Importance of Nitrogen.

Nitrogenous.*		Phosphatic.	
Fertilizer.	Quantity.	Fertilizer.	Quantity.
	Tons.		Tons.
Sulphate of ammonia	4,500,000	Bones	330,000
Calcium cyanamide	1,100,000	Basic slag	5,700,000
Nitrate of lime	965,000	Superphosphate	16,900,000
Miscellaneous salts†	1,100,000	.. .. .	..
Chilean nitrate of soda	3,475,000	.. .. .	..
Totals	11,140,000	.. .. .	22,930,000
Potassic.		Nitrogenous-Potassic.	
Fertilizer.	Quantity.	Fertilizer.	Quantity.
	Tons.		Tons.
Potassic salts	5,700,000	Animal, &c., organic materials, chiefly valued for nitrogen	3,000,000
	5,700,000		3,000,000

* Amount of nitrogenous, including organic materials, in total production = 33 per cent. of all fertilizers. (Total world production = 42,770,000 tons.)

† Includes new synthetic materials: Ammonium-sulphate-nitrate, nitrophoska, ammonium phosphate, cal-nitro, ammonium chloride, calurea, potassium nitrate, &c.

largest contributors—the Chilean nitrate and the by-product ammonia industries—about 90 per cent. finds use in agriculture. The remainder is chiefly requisitioned for manufacture of high explosives. Other uses are for refrigeration and the manufacture of numerous chemicals. The phenomenal progress in production of air-derived nitrogen is instanced by the fact that twenty years ago only 25,000 tons were made, whereas last year's output was nearer 1,250,000 tons, equivalent to, say, 7,590,000 tons of pure nitrate of soda.

CONVERSION OF ATMOSPHERIC NITROGEN INTO FERTILIZER COMPOUNDS.

Fixation of nitrogen from the air into compounds indispensable in agriculture, industry, or war is capable of being rapidly carried out by various complicated and rather costly technical processes. Three methods are, or have been, widely exploited, the chief and most successful being the direct synthetic ammonia process, originating out of the inventions of Haber and Bosch, two German technologists. Two older, less used methods are known as the "cyanamide" and the "arc" processes respectively. Modifications of the original system of Haber-Bosch which possibly may be regarded as distinct processes have, of course, been adopted by numerous nitrogen-fixation firms, who have elaborated on ideas and inventions pertaining to the production of ammonia (nitrogen plus hydrogen) by direct synthesis.

The fixing or holding of atmospheric nitrogen in utilizable forms of compounds such as ammonia or nitric acid is, for the most part, merely a preliminary to further conversion into suitable materials for trade. Various inorganic nitrogenous salts in solid form carrying rapidly water-soluble plant-nutrient matter may be made to formula by uniting synthetic ammonia, not suitable under ordinary conditions for fertilizer use alone, with sulphuric, phosphoric, hydrochloric, or carbonic acids to form the respective sulphate, phosphate, chloride, and carbonate salts of ammonia. Likewise nitrates may be formed by neutralizing nitric acid, synthesized from air nitrogen, with basic substances—lime, soda, or potash—to form respectively nitrates of lime, soda, and potash.

The four main compounds processed from air nitrogen are sulphate of ammonia, calcium cyanamide, and the nitrates of lime and ammonia. Complete fertilizers with high concentrations of plant-food—for example nitrophoska—referred to earlier in this series of articles are made by combining either ammoniacal or nitrate forms of nitrogen with phosphoric acid and potash.

Haber-Bosch Process.—This system, developed for many years exclusively in Germany, involves the use of air, coal, and water as main raw materials. To-day, however, it is extensively exploited throughout Europe and America. The operation of the process depends on the direct union of air nitrogen with hydrogen, the latter being obtained from water by electrolysis or from coal. Although not so much depends upon cheap electric power as with the other two systems discussed further on, the process requires a great amount of technical skill in manipulation. The synthesis is carried out under conditions of high temperature and pressure; the ammonia solution ultimately produced being the starting or primary material for production of many different forms of combined nitrogen, such as nitrates or ammoniates, as the

case may be. Mention may be made of the Ostwald process, with the aid of which ammonia is convertible into nitric acid. From nitric acid various nitrates can be built up either for military or fertilizer use.

The first commercial Haber plant, with a capacity of 25 tons daily, commenced operating in Germany in 1913. To-day 91 out of an estimated 126 or more air-nitrogen plants are reported to be based in some way on the Haber-Bosch principle. Even if a large number of these plants are looked upon as functioning as distinct processes—such as the Claude, Fauser, and Casale—a notable point is that the greater portion of synthetic nitrogen materials produced has come from a few very large installations which are equipped with the Haber-Bosch apparatus. The two immense works, occupying an aggregate area of almost 2,000 acres, belonging to the German chemical organization I.G. Farbenindustrie A.G., together with the great up-to-date efficient works of Imperial Chemical Industries at Billingham, Stockton-on-Tees, the largest in the British Empire, are capable, if need be, of turning out anything up to 1,000,000 tons of pure nitrogen yearly by the direct synthetic method of ammonia production.

Experts affirm that future international demands will be satisfied principally by the Haber-Bosch process or modifications thereof, as definite advantages are held by it over all other systems of nitrogen fixation. An indication of the latest trend is exemplified by the construction of a small Haber-Bosch works—presumably the first in the Southern Hemisphere—near Johannesburg in South Africa. Japan apparently is also operating a large lately constructed plant (capacity 235,000 tons of fixed nitrogen annually) with the Haber-Bosch equipment.

The Cyanamide Process.—This was one of the earliest to be exploited. The first factory commenced as far back as 1906, but notwithstanding such an early beginning the process has made far less progress than the direct synthetic ammonia method. For economic manufacture of calcium cyanamide, the principal marketable article of the system, cheap sources of electric energy, coal, and limestone are essential. Such countries as Norway, Sweden, Italy, Switzerland, Canada (at Niagara Falls), &c., where abundant water-power for generating electricity is available, have been selected hitherto as suitable locations for erection of plants.

The bare outline of procedure for production of cyanamide is as follows: Lime and coke are brought together at red heat in an electric furnace to form calcium carbide, which is broken up and packed into a smaller electric oven, and pure nitrogen separated from the atmosphere by a special liquefaction process is then introduced. The carbide mixture is well heated to enable the nitrogen to be absorbed or fixed by the carbide to produce the calcium cyanamide.

Calcium cyanamide can be changed into ammonia, the preliminary material from which further products, such as ammonium phosphate, can be manufactured. Urea, a well-known concentrate briefly described further on, is also obtainable from cyanamide.

In spite of many reported defects, the "cyanamide process" is still producing combined nitrogen in considerable amounts; Germany had a production of roundly 408,000 tons of cyanamide in 1930, while Canada with 142,000 tons, and Poland with 125,000 tons follow. (See Table 2 for world production in 1928.)

The Arc Process.—The commercial operation of this process depends on the passage of ordinary air through an electric arc furnace to promote direct combination of nitrogen and oxygen at the temperature of the arc to form nitric oxide, a gas which is convertible into nitric acid for the preparation of nitrates.

Numerous authorities now appear to be convinced of the inefficiency of the arc method for production in relation to the extraordinary amount of power consumed. In Norway, where cheap electric power is obtainable, the process worked relatively well until recently in providing large quantities of nitrate of lime, &c., for trade. However, the output of the same material at German works where the Haber-Bosch apparatus is installed far exceeds the recent Norwegian production of this commodity. Very few plants function on the arc principle to-day, the tendency even in Norway being for their replacement with direct synthetic ammonia units. In 1930 Germany produced 350,000 tons of nitrate of lime, against Norway's 149,000 tons.

SYNTHETIC NITROGEN PLANT-FOOD CARRIERS.

As many factors play a part in determining the effectiveness of various nitrogenous fertilizers in practice, only very general and abridged statements will be made here regarding their properties or behaviour.

Sulphate of Ammonia.—Not only is this the chief fertilizer of the air-nitrogen industry, but it is also produced in large quantities as a by-product of the coking and coal-gas industries.* As a fertilizer it is very well known, widely used, and comparatively cheap. It holds first place in world nitrogen production (see Table 1), and for the greater part is the product of large ammonia plants.

The first method of manufacture several years back was dependent upon the treatment of ammonia with sulphuric acid in order to obtain the sulphate, but on account of the scarcity of sulphur deposits for making sulphuric acid, gypsum (sulphate of lime), which occurs in abundant natural deposits, was found to be a satisfactory substitute for sulphuric acid. The latter procedure is followed by the English chemical organization working a modified Haber-Bosch nitrogen plant at Billingham and by the German works at Leuna and Oppau. All three installations have been built within easy reach of extensive gypsum deposits.

The method of production is briefly as follows: Gypsum meal, suspended in water, is churned with ammonia and carbon dioxide, resulting in the formation of carbonate of lime and sulphate of ammonia, the solution of the latter being subsequently evaporated to dryness to obtain the saleable article. The precipitate of lime carbonate, after being filtered off and dried, is combined with ammonium nitrate, thereby enabling the commercial production of new types of plant-food carriers sold under the names of Nitro-Chalk and Calnitro, &c., which are dealt with later.

Sulphate of ammonia is a whitish, crystalline, readily soluble salt without odour. Generally it is bought on a guarantee of 20.6 per cent.

* By-product sulphate of ammonia, together with Chilean nitrate of soda, will be briefly treated in a continuation of the present article.

nitrogen. Two types have been procurable locally within recent years—the dry neutral and the acid type. The latter, a by-product of a few old fashioned coke-oven or coal-gas plants, contains usually a small amount of sulphuric acid (from 0.1 to 0.3 per cent.), which causes bag-rotting and loss of physical condition. The dry, neutral material from large up-to-date plants has a much better mechanical condition for drilling or sowing by hand. In addition, it does not take up moisture from the air and become sticky quite so readily as nitrate of soda or other nitrates.

The recently developed practice of directly ammoniating superphosphate with either gaseous or liquid ammonia obtainable at low cost lends itself readily to the more economical manufacture of manurial mixtures. In the United States, in particular, the practice has become well established in that it avoids the expensive process of converting ammonia through the intermediate stage of sulphate of ammonia. More recently a solution of ammonium nitrate in ammonia has been favourably considered as an alternative to ammonia alone for treating superphosphate. Apparently it is customary for both synthetic and by-product ammonia to be delivered to fertilizer-works in specially designed steel-tank cars, the contents of which can be diluted with water and sprayed on to superphosphate for absorption.

Sulphate of ammonia employed in local farm practice at the present time is of the synthetic type from Great Britain. Most of it is either in the first place utilized by commercial mixers for preparation of ammoniated superphosphate, &c., or is applied to pastures and general farm crops in conjunction with phosphates and potash. Small amounts also go to top-dress lawns, golf-greens, &c. That increasing quantities have been used within recent years is manifested from importation returns: From 1912 to 1921 3,800 tons were delivered to the Dominion, in comparison with 26,900 tons for the period 1922 to 1931. The quantities of Chilean nitrate of soda imported for the same periods were 3,736 and 10,722 tons respectively.

Nitrate of Ammonia.—This is a highly concentrated, rapidly acting compound containing 35 per cent. of nitrogen, half being as ammonia and half as nitrate. Its manufacture is accomplished by converting ammonia into nitric acid, which is neutralized with more ammonia to form the nitrate. For explosives-manufacture it is of importance, but as a fertilizer it has the property of absorbing moisture from the air, which constitutes a drawback to its physical condition. Another disadvantage is its liability to explode when subjected to violent detonation or brought into contact with fire. In mixture with certain other materials it is quite safe for use.

Nitro-Chalk.—About 44 per cent. of nitrate of ammonia occurs as the plant-food carrier in this comparatively new addition to the fertilizer trade. Apart from having 15.5 per cent. of water-soluble nitrogen—half as nitrate and half as ammonia—nitro-chalk contains 48 per cent. of precipitated lime carbonate. Not only does this render the ammonium nitrate safe for handling and lessen its hygroscopicity and thus improve its mechanical condition, but also tends to reduce soil-acidity. Nitro-chalk is available in granular form chiefly to British consumers from the Billingham air-nitrogen factory, at a considerably lower price than Chilean nitrate of soda.

Calnitro.—A proprietary product of German works, of slightly higher strength, but nevertheless similar to nitro-chalk. An interesting feature of this product is that its granules are coloured green to facilitate identification. The practice of giving a distinctive colour to certain synthetic preparations shows promise of extension, as further new grades come forward. Calnitro has 35 per cent. of precipitated lime and 20.5 per cent. of nitrogen in its composition. To preserve its mechanical condition it is packed in moisture-resistant bags. Minor quantities of it have been used in our Canterbury wheat-lands and for various other experimental purposes.

Leunasalpeter.—A concentrated double salt of nitrate of ammonia and sulphate of ammonia prepared in large quantities in Germany. It is guaranteed to analyse 26 per cent. of nitrogen, a quarter being as nitrate and the rest as ammonia.

Kali-ammon-salpeter.—Another German formula stated to be of good physical properties, and consisting of a mixture of chloride of potash and nitrate of ammonia. The analysis is 16 per cent. nitrogen and 27 per cent. potash.

Chloride of Ammonia.—A yellowish-brown salt of good physical character, containing 24.26 per cent. nitrogen, prepared by treating common salt with synthetic ammonia and carbon dioxide, which results in the formation of bicarbonate of soda and chloride of ammonia, the latter being separated from the former. Owing to its high cost until lately it has not found much sale, but in Europe to-day large amounts are marketed. In efficiency it is said to compare very well with the sulphate form of ammonia. A further combination of chloride of ammonia with chloride of potash (10.11 per cent. nitrogen and 20.24 per cent. potash) sold under the name of potazote is a special line developed and marketed in France.

Large quantities of synthetic ammonia are also employed in the preparation of phosphates of ammonia, &c., as dealt with in an earlier article of the present series (*Journal*, September, 1931).

Urea.—This is produced when ammonia and carbon dioxide are brought together under suitably controlled conditions. It is a white, fine, crystalline substance with an exceptionally high concentration—46 per cent. of water-soluble nitrogen in organic form.* The pure article leaves no alkaline or acid residue in the soil, and gives a somewhat slower response than either nitrate of soda or sulphate of ammonia in assisting vegetative growth.

Manufacture of urea is conducted on a large scale in Germany, the product being put up in special moisture-resistant containers. From this source small quantities have been retailed for local market gardens, &c., but owing to its moisture-absorbing qualities interfering with its physical condition, a little difficulty has attended its utilization. From all accounts good use has been found for it in Auckland Province when suitably mixed with dry ground rock phosphate.

Rothamsted reports (1927-28) refer to urea as comparing favourably with sulphate of ammonia in field trials. Moreover, having the

* Although urea, cyanamide, and derivatives of urea contain organic nitrogen, they are included in this article for the sake of convenience.

advantage of containing 46 per cent. of nitrogen, as compared with 20.6 per cent. in sulphate of ammonia. it should prove useful for saving weight in transport to remotely situated farms.

Calurea.—A high-analysis combination of nitrate of lime and urea, with one-fifth of its nitrogen (6.8 per cent.) as nitrate and four-fifths (27.2 per cent.) as urea. It is likewise manufactured in Germany, and has a physical condition similar to urea.

Phosphazote (Superphosphate of Urea).—Containing 7 per cent. of nitrogen and 12 per cent. of phosphoric acid, this is a special compound converted from cyanamide in certain French and Swiss factories.

Urea-Potash-Phosphate.—Another specially developed proprietary line of very high fertilizing quality, which has appeared on the European market. This complete combination, reputedly well-adapted for market gardens and for saving bag and transport costs, contains 28 per cent. of nitrogen in three different forms—nitrate, ammonia, and amide—as well as 14 per cent. of potash and an equal amount of phosphoric acid. It consists of a mixture of urea, diammonium phosphate, and nitrate of potash in certain proportions.

Cyanamide of Lime (Calcium Cyanamide).—A grey to black powder or granular material of rather peculiar chemical properties, manufactured by the cyanamide process. The modern product has a distinctly improved mechanical condition, being easily drillable compared with the earlier article Nitrolim. In Europe and the United States cyanamide, although sold for its nitrogen, is popular as a drier or conditioner of mixed manures, and it is in this particular direction that attention is centred on it in the fertilizer market. Commercial grades contain usually about 20–22 per cent. of insoluble cyanamide nitrogen, together with 22 per cent. or more of free lime and 10–12 per cent. carbon, which latter gives cyanamide its black colour. Added to the free lime it has lime in combination as calcium cyanamide, giving it a total content of 60 per cent. (or 1,344 lb. per ton) of lime or more. Cyanamide in comparison with other normal strength nitrogen fertilizers is reasonably priced.

By reason of the high lime content referred to the product leaves an alkaline residue in the soil, which is capable of effecting an appreciable reduction of soil acidity. If unsuitably stored it undergoes deterioration, forming a complex poisonous compound—dicyanodiamide—injurious to young plants. Even under normal conditions the customary plan is for cyanamide to be applied before seeds or plants are put into the soil owing to its injurious effect on seed-germination or tender growth when brought into close contact.

As now marketed the material after having been subjected to an oiling process is far more easily handled than the dusty, cruder product of former years. At times, even after oiling, there is a tendency for certain grades to cause skin inflammation to users. For destroying weeds unoiled raw cyanamide has considerable utility. In Great Britain and on the Continent of Europe it is in good demand for the destruction of charlock and cornflower, two troublesome weeds in cereal crops.

Nitrate of Lime.—This is the lime salt of nitric acid. A standard grade commodity which has until recently been made principally in Norway by the electric arc process, but large quantities are now prepared from synthetic ammonia at German air-nitrogen factories. Commercial samples yield 15.5 per cent. of nitrogen and 28 per cent. of free lime.

Like many more crystalline synthetic compounds it tends to deteriorate physically through absorption of atmospheric moisture, necessitating special treatment with oil for checking its deliquescent properties as well as the use of drums or waterproofed bags. In productive value this salt is on a level with nitrate of soda, its lime content being of advantage for effecting decreases in soil lime-requirements.

Nitrate of Soda.—A pure, granular product with much the same characteristics as Chilean nitrate. It is manufactured synthetically in Europe and the United States from ammonia oxidized into nitric acid, which is made to react with soda ash to form nitrate of soda, subsequently obtainable in the solid state by evaporation. Notwithstanding the complicated nature of the apparatus required for its manufacture, the product is reasonably priced. On the English market it is quoted at approximately the same figure as Chilean nitrate of soda by Imperial Chemical Industries, who have commenced the manufacture of small quantities at Billingham.

Nitrate of Potash.—This concentrated crystalline salt of fairly good physical properties, yielding 13 per cent. nitrogen and 44 per cent. potash, has also been procurable lately as a synthetic substance. Well recognized to be of a highly stimulating character, this product is specially useful for market gardens, fruit crops, &c., and for incorporation in mixed manures. At one time it was expensive and difficult to procure on account of production being chiefly confined to natural deposits in India, but since the advent of the synthetic means of manufacture, its price has dropped considerably.

SALE AND UTILIZATION OF NITROGEN.

It will be readily observed from the foregoing descriptions that a wide range of novel compounds have been skilfully developed; indeed, their many different formulas, variations in price, and unusual appearance are quite a feature of the modern fertilizer trade. Quite likely the discrimination shown by agriculturists for different types of nitrogenous fertilizers in the past and the fact that some have a wider utility than others has partly accounted for this exceptionally wide choice. Another reason may be due to the efforts of manufacturers to comply in a general sort of way with one of the fundamentals of fertilizer practice—namely, that full benefit can be obtained from a fertilizer only if its ingredients are so balanced as to be suitable for particular soil conditions and crop requirements.

The comparative agricultural values of different types of nitrogenous materials have formed, of course, the subject of countless field trials, but the fact remains that the experimental stages have by no means been passed in respect of some of the newer compounds. There is every possible chance that research now in progress will point the way to their proper use. Discoveries of further new substances and technical improvements in manufacture are also to be justifiably expected. To this latter end there is a noteworthy move toward improving the quality of certain concentrated nitrogenous types by introducing more lime into their composition to provide for the leaving of beneficial alkaline rather than unwanted or harmful acid residues in certain classes of soil. Every effort, too, is being directed to the amelioration of defective physical condition of otherwise attractive materials, and in manufacturing suitable mechanical devices for their economical distribution.

A few years ago the employment of inorganic nitrogenous fertilizers could not always be regarded as an economic proposition, but with the modern electro-chemical mass methods of manufacture it is not improbable that prices—especially of nitrates—will come down to an even lower level than at present. Consumption of nitrogen in New Zealand agriculture, although relatively insignificant, will doubtless slowly increase with the more intensive development of farms and orchards as time goes on. On the other hand, the importance of utilizing natural nitrogen resources by the ploughing in of legumes, &c., as well as the conservation of live-stock manures, cannot be overlooked.

(To be continued.)

GERMINATION CAPACITY OF PERENNIAL RYE-GRASS IN RELATION TO PRICE.

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THE opinion that perennial rye-grass seed will not germinate well artificially and that some special property of the soil is necessary to induce complete or nearly complete germination is being given publicity in certain districts. It is understood that many buyers of certified rye-grass seed have practised a very doubtful economy in purchasing lower-priced lines on the understanding that the seed will germinate quite satisfactorily in the soil. Notwithstanding reports of "wonderful strikes," &c., the field germination percentage of practically all grass and clover seeds is invariably lower than that obtained artificially in a germinator. Any statements to the contrary may be disregarded entirely. It has been shown that the non-germinating seeds in low-germinating lines of perennial rye-grass are abnormal, and that, as the germ is non-existent, growth under any circumstances cannot take place.*

At a price commensurate with the quality of the seed offered, some buyers may find good value, but at the reported prices paid for some of the lines offered, the value received in pure germinating seed is, per shilling expended, very much lower than were higher-priced, high-quality seed purchased. Seed-vendors are business men, and if in the vendor's opinion a line of certified seed is worth only 6s. to 8s. per bushel, when first-grade is selling at two to three times as much, then it may be taken for granted that, notwithstanding a reputed field performance, the line under offer is not up to standard in some particular.

Relevant also is the idea, given some publicity last year, that seed of perennial rye-grass of superior type invariably shows a very low germination percentage—in fact, that the lower the growth percentage the more superior the type as a perennial. There is no evidence to suggest any direct relationship between strain and capacity to germinate. It is true that in certain districts the perennial strains appear to be more susceptible to conditions which result in the loss of the viability of a large proportion of the seeds.* The germination capacity of seed of perennial rye-grass grown under conditions suitable to seed-production is invariably very high, as is evidenced by this season's average germination percentages of 98, 96, and 97 for Hawke's Bay, Poverty Bay, and Canterbury certified seed respectively.

* See *Journal*, May, 1932.

THE WASTE LANDS OF NEW ZEALAND.

AN UNDEVELOPED ASSET.

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Introduction.

THE principal kinds of waste lands in New Zealand* are: (1) The dune sands, and (2) the estuarial mud-flats, lagoons, shallow lakes, and other areas permanently or temporarily submerged by fresh, salt, or brackish water which exist throughout the Dominion. The surface of the dunes is broken in contour, and ranges from sea-level up to 200 ft. in elevation. It is sparsely colonized by plants which have a specialized structure enabling the plant to resist drought and burial by moving sand. The surface of the second type of waste land is unbroken save for cracking on drying and occasional shallow creek-beds. In most cases the area is little raised above sea-level. The vegetation of this type varies from nothing to mangrove associations—that is, small forests—and may include pure associations as eel-grass (*Zostera*), salt-weed (*Salicornia*), sea-rush (*Juncus maritimus*), or Purua grass (*Scirpus maritimus*).

It is intended to deal in greater detail with these waste lands in subsequent contributions; for the present it will be sufficient merely to introduce the subject with some general observations.

The utilization of New Zealand lands, especially those of the North Island, has been generally initiated by occupying areas which offer the least resistance in the first years to colonization by remunerative plant-growth. No consideration in the past was given to the question of available or total plant-food in the soil or to the physical state of the soil. Lands were classified on consideration by the practical man on what other lands which looked similar would do; and if pasture plants grew well on any portion of the area it was assumed that the animals eating those plants would also grow well, an assumption which has proved to be untenable for great areas of coarse-textured soil ranging from sands to fine gravels in the bush-sick region. With this exception, the methods of opening up lands for settlement have worked well on the whole, with the aid of many millions of tons of imported phosphate which it has been necessary to apply in order to reinforce the naturally poor plant-food content of average North Island soils. Soils naturally rich in phosphates and lime have been neglected because they offered engineering difficulties in bringing them into profit. One apparent exception to this is the great drainage policy by which such areas as the Hauraki Plains and the Rangitaiki Swamp have been dealt with and successfully brought under farming occupation. But these are not really exceptions, since only a relatively small portion of them is exceptionally rich in available phosphate or lime.

THE SAND DUNES.

A very large area—stated to be 300,000 acres—of sand dunes, is available for reclamation. The examination of only a small part of these has been completed for chemical analyses, but if those areas which

* By "waste lands" is meant those areas not growing forest, native flax, grasses, or other plant staples in sufficient quantity to warrant utilization.

have not been examined are as rich in phosphates and lime as those of the Manawatu district, then a great tract of land is available for reclamation, with mineral plant-food present in abundance which would rapidly grow many green-manuring crops for reinforcing the deficient organic matter. Such land has the advantage that it can be worked in all weathers, and, being contiguous to the sea, could be connected up with adjoining occupied areas, fenced, roaded, watered, and bridged at a moderate cost compared with the cost of doing this in most new settlements, which are usually at a distance from rail or harbour.

The large quantity of those elements, phosphorus and calcium (usually so deficient in New Zealand soils), in lands but recently derived from the sea, is due to the abundance of marine life which has concentrated in the animal and plant remains—the calcium and the phosphorus derived from the sea. In many places when primeval man or early settlers have had their homes by the sea they have also contributed a share of the phosphates so abundant on littoral situations, and it should be remembered that the phosphate in these areas is largely available—that is, it is equivalent to a recently applied dressing of superphosphate. This may be partly due to the presence of excessive calcium which prevents the reversion of phosphate to an unavailable form, and partly to the solvent action of sodium derived from the sea-water in attacking the rocky material chemically and disintegrating it.

The sterility of the dune area immediately contiguous to the sea is often thought to be due to sea salts, but analyses of these sands affords no support to this idea, although the time at which the maximum amount of salt is present may have been missed at any time the samples were drawn; but certain it is that no analysis shows any such high content of chlorides as would account for the sterility of the fore-dune and some of the after-dunes. It may be that the alkaline reaction of such sands is inimical to the growth of ordinary pasture-plants, although such specialized grasses as the naturalized marram (*Ammophila*), the beautiful silvery New Zealand spinifex, and the pingao sedge (*Scirpus frondosus*) are able to flourish on the fore-dune. The point has rather an important economic bearing, as if the alkaline reaction of sands is proved to be the cause of the sterility for ordinary pasture plants it would help to establish the recognition of the fact that it is unsafe to lime sandy soils like pumice lands, owing to the bad effects on the stock and the lack of response in the pasture.

In the transformation by plant life of raw mobile sand full of small pieces of shell into grassed dune suitable for grazing stock lime-loving or lime-tolerating plants assist and flourish at the coast. These, as one proceeds inland, gradually become less aggressive, less healthy, finally disappearing and giving place to plants which flourish in or at least tolerate a neutral or acid soil. The organic matter accumulates now, forming an acid sandy soil, and this is a suitable medium for the growth of pasture plants. These eventually form a sward which the wise farmer does not attempt to improve by cultivation and resowing, but relies on top-dressing, because once the covering of humus is destroyed, it may be difficult to obtain a sward again on sand.

* Crystals of pure phosphate of lime (apatite) occur in Taranaki ironsands.

One of the most interesting researches on sand dunes is that of Dr. E. J. Salisbury, dealing with the Southport (England) dunes. This worker was able to correlate the change in chemical and botanical composition with the age of the dune. There is a recession of the sea at Southport, and the age of each series of dunes can be learnt by reference to old maps, one dating so far back as 1610. The chief change is the leaching out of the calcium carbonate of the sea-shells, and the change in the reaction from being alkaline on the two-year old dunes (pH 7.2-8.2) to decided acidity at those dunes over two hundred years old (pH 6.2-5.5).

The gradual transformation of the plant covering from what are known as lime-loving plants (calcicoles) to lime-hating plants (calcifuges), is well shown in researches on dune vegetation generally. Every gardener knows that it is fatal to lime rhododendrons, which belong to the great *Erica* family represented in England and New Zealand by such plants as ling (*Calluna*) and the other heaths, and the growth on this type of soil is indicative of the changed quality of the soil, which, with the leaching-out of the calcium carbonate, has become acid. Manuka (*Leptospermum*) is a New Zealand plant that will not tolerate an alkaline soil. Accordingly, this is found at the back of the outer fore-dune and not on it, for here the lime-requirement is negative. Occasional manuka plants may occur close to the inner fore-dune, but the growth is not aggressive. At Southport the "Heather Dune," 280 years old, contains only 0.03-0.19 per cent. of calcium carbonate (pH 5.5).

What nature can accomplish in 280 years in fixing and populating with plants the shifting dunes, man can accomplish in a much shorter time by introducing more rapid methods of improvement—the engineer to level, road, and bridge, and the agriculturist to reinforce a sparse organic matter content by growing special crops for fixing the sand, for ploughing in, or for sale, these special crops being able to flourish in the special environment. The special pasture staples may be quite as good as those commonly used; for instance, it is known that strawberry clover (*Trifolium fragiferum*) will grow in brackish water and is equal to white clover in results when fed to stock. Experimental areas on the dunes are needed so that systematic observations may be recorded.

The results of the examination of the Manawatu dunes may be found in Volumes 20 and 21 of this *Journal*. It is thought that there is a recession of the sea on this coast, one landowner stating that the rate at which this is taking place amounts to a chain in ten years, so that if this has been uniform throughout the breadth of the dunes it would have taken 800 years for the shore to progress a mile seaward. Half a mile to a mile from the sea there is, however, now still about four times the available phosphate that there is in ordinary New Zealand soil, and 1 per cent. of calcium, which is more than twice the amount found normally. The grazing value of the fixed dunes is very variable, as the inter-dune land is often wet and even swampy, which affords stock a complete change of pasture from the somewhat short, dry, poorer grasses of the dunes. Some of the drained swamps which have been converted from flax (*Phormium*) to dairy pastures support quite high-class pasture.

These Manawatu dunes exist in a region of good rainfall—about 40 in.; also there are sometimes droughty spells in summer. Enough rain, however, falls to grow many green-manuring crops, and there is evidence that the material composing the sands, although of fairly uniform size (technically speaking, “fine and coarse sands”) have not been weathered as much as dune sands in most other parts of the world where they have been the subject of research. Usually dune sands consist of the harder portions of rock matter which is largely quartz (oxide of silicon or silica), a substance which supplies little or no plant-food. Such dunes are usually white or yellowish, whereas the Manawatu dunes are of a distinctly drab colour, which betokens a large admixture of the original unweathered rock whence the sands were derived. This has a direct effect on the fertility of the Wellington dunes. The experience of those who have made gardens on dunes, and who have taken the trouble to apply organic manures liberally, is that there is no finer material upon which to garden.

THE BRACKISH OR SALT LAKES, LAGOONS, AND ESTUARIES.

These areas are now receiving considerable attention from public bodies in New Zealand, who contemplate land-reclamation on a large scale assisted by labour at present unemployed. No more fascinating problem has presented itself for years than the utilization of these potentially valuable waste lands, now either slightly submerged or abandoned to wild inedible plants, the animal life there finding a congenial home and constantly enriching the area with phosphates.

Throughout the many contributions on New Zealand soils scattered in this *Journal* and other official publications during the last thirty years, the fact is prominently patent that littoral lands of all kinds are worthy in the highest degree of the engineer's and farmer's attention. They are often more accessible than the sand-hills, many areas being close to the cities and other densely populated centres. For the same reasons that the sand dunes are so rich in mineral matter other than silica—that is, the material has not travelled far and is imperfectly weathered—the estuarial lands have not reached in many cases that stage which is found in Europe under similar conditions, where a stiff soil or clay composes the bed of the type of land now being drained. In New Zealand these lands are composed of sand, silt, clay, and shells in well-balanced proportions, and these components, theoretically, ought to make the best of all soils technically known as loams.

Attention in the world of agricultural science is now being directed to the gigantic scheme of the Dutch authorities in draining the Zuyder Zee. An International Soil Congress is being held at Groningen this month from which much of interest may be learnt, as provision has been made whereby the Dominion will be represented, and members will visit the reclamation site. The problem in Holland is complicated by the fact that the land when drained will be a clay soil. Clay makes the most intractable soil to work at any time, but when salt water has been mixed with the clay the treatment of the soil is rendered more difficult and the utilization of the land is delayed.

In New Zealand heavy or clay soils are the exception rather than the rule, and it is anticipated that the estuarial lands when drained will

offer no great difficulty in the rapid leaching away of injurious sea-salts. In some cases shell beds alternate with mineral matter, mud, silt, or sand. In times of exceptional deposition from floods the sea animals have evidently been killed out, and the shells, largely carbonate of lime, when mixed with the mineral matter in cultivating will, it is hoped, mitigate or altogether prevent any ill effects which may result from the action of sea salt on the clay particles.

On some of these reclaimed lands special crops may have to be grown at first. Most vegetables will grow admirably on light soil with a fair percentage of salt in it, as the ancestors of these vegetables originally inhabited a coastal situation. Thus all the cabbage family is derived from the colewort, a maritime plant, and the beet and mangold from *Beta maritima*. Nearly all the cress family (Cruciferae), such as mustard, kale, rape, radish, and kohlrabi, are suitable as crops in salty situations, but probably the most payable of all for market-gardening purposes will be asparagus, of which in 1930, 93 tons were imported tinned, mostly from America, valued at £7,000. Why could not this have been produced in New Zealand, and why could not vegetable produce of all kinds be exported from this country where it is so easily grown?

The Hauraki Plains soils near the sea contain six times the amount of available phosphoric acid that exists in ordinary soil (see this *Journal*, June, 1914, p. 574). The Lake Ellesmere (Canterbury) lagoon, occupying 100 square miles, is equally rich in phosphate. The Nelson (Wakapuaka) mud flats (see this *Journal*, August, 1919, page 78) contain about four times the phosphate, the Lake Grassmere (Marlborough) two and a half times, the Blueskin Bay (Otago) four times, and the Napier (Ahuriri) lagoon three to four times the amount of phosphate normally found in fertile soils. These figures are considerably on the low side where there is much carbonate of lime present, which interferes with the method used in spite of corrections made to prevent it.

(To be continued.)

STOCK SLAUGHTERED, 1931-32.

FOLLOWING are the numbers of stock slaughtered at abattoirs, meat-export works, bacon-factories, and ordinary registered slaughterhouses throughout the Dominion during the year ended 31st March, 1932:—

Stock.	Abattoirs.	Meat-export Slaughter- houses.	Bacon- factories.	Ordinary Slaughter- houses.	Totals 1931-32.	Totals 1930-31.
Cattle ..	135,224	131,624	..	56,094	322,942	326,128
Calves ..	54,461	537,003	..	1,565	593,029	551,760
Sheep ..	788,045	3,430,176	..	246,673	4,464,894	3,564,005
Lambs ..	199,377	8,459,244	..	30,575	8,689,196	8,092,802
Swine ..	131,369	246,048	31,808	21,689	430,914	449,490

—Live-stock Division.

ORCHARD SPRAYS IN NEW ZEALAND.

III. THE COPPER SERIES.

G. H. CUNNINGHAM, Mycologist, Plant Research Station, Palmerston North.

CERTAIN copper salts are among the most valuable fungicides known, and, together with sulphurs, form the principle fungicides in use in commercial orchards. Copper sulphate was the first copper spray to be employed, according to Lodeman (1913), for about 1881 it was used in France in the form of a 1-per-cent. solution as a winter wash to combat black-spot of apple-trees. The results secured were of uncertain value, so that the fungicidal properties of copper were really not recognized until the application of bordeaux mixture in 1883. Subsequently, numerous combinations were tried in which copper sulphate was combined with ammonia or soda, leading to the production of the lesser-known cupramonium and burgundy sprays.

As bordeaux mixture is the most important of the copper sprays, it is discussed first in this article, other copper sprays being dealt with in the second part to follow next month.

1. Bordeaux Mixture.

The discovery of this fungicide was made by Millardet in October, 1882, when passing through the grape-growing district of St. Julien in Medoc, about twenty-five miles north of the city of Bordeaux, in France. He noticed that although the leaves had fallen from vines throughout the district (owing to the ravages of downy-mildew, *Plasmopara viticola*) they still adhered to plants bordering the roadside. On investigating the reason for this he found that it was the practice for growers in this region to sprinkle with verdigris or a mixture of copper sulphate and lime the leaves of vines contiguous to the roadsides, with a view to making them appear as if poisoned, and thus act as a deterrent to petty thieves. Millardet rightly concluded that the persistence of the leaves of plants so treated was in some manner connected with the materials used, and accordingly arranged for a series of tests to be conducted in the following year. As a result, he found that of the numerous salts of metals tested the combination of copper sulphate and lime gave most promising results as a controllant of downy-mildew.

The first formula recommended in consequence of these preliminary experiments (17-33-25) produced a thick paste, which of necessity had to be sprinkled on to leaves and fruits with fibre brushes made of bundles of twigs bound firmly together (Millardet, 1885). Millardet, with the assistance of the chemist Gayon, then modified the proportions, and introduced an improved formula in which the copper sulphate and lime were in the proportions of 3-1-11 (Millardet and Gayon, 1887). The formulæ and methods of preparing this spray have subsequently undergone numerous changes, as will appear, and even to-day finality has not been reached.

The common name of this spray, bordeaux mixture, is a translation from the French (*boullie bordelaise*), and is derived from the district in which it originated.

COMPOSITION OF BORDEAUX MIXTURE.

Bordeaux mixture is prepared by bringing together solutions of copper sulphate and lime. Combination takes place between the copper sulphate and lime with the formation of a chemical compound, the composition of which differs according to the proportions of the chemicals used. Copper sulphate is readily soluble in water, for 1 gallon will dissolve slightly less than 3 lb. at a temperature of 60° F.; but lime is only slightly soluble, since 1 gallon of water at 60° F. will dissolve but 0.27 oz. of the hydroxide, and the solubility actually decreases with an increase of temperature.

It would appear that the first reaction that takes place following mixing of these two compounds is the formation of a chemical compound known as a basic sulphate or trioxysulphate, $4\text{CuO} \cdot \text{SO}_3$ (Pickering, 1907; Martin, 1932). Should there be less or just sufficient lime present to precipitate the whole of the copper, no further chemical action takes place. This condition is reached when the ratio is in the proportions of one part by weight of copper sulphate to 0.169 part of calcium hydroxide = approximately 6:1, or, in chemical equivalents, 1:0.75 (Millardet and Gayon, 1887; Pickering, 1907; Martin, 1932). Should lime be added in excess, further reactions occur, and the nature of these has been the subject of considerable diversity of opinion by many of those who have studied the subject.

The most recent explanation as to what happens is that of Martin (1932), who, by applying electrochemical methods, was able to demonstrate that when calcium hydroxide was added in excess of this 1:0.75 ratio of chemical equivalents, the trioxysulphate was decomposed slowly until a ratio of 1:1 was reached, at which point permanent alkalinity was attained. During this addition the sulphate radicle is eliminated with formation of a blue precipitate of hydrated cupric hydroxide, which retains by adsorption part of the sulphate radicle. It would appear that this adsorption of the sulphate radicle has been responsible for the statements of Pickering and others that a series of complex basic sulphates was formed when lime in excess of this ratio was added. This reaction is completed when the copper sulphate and lime are in the proportions (by weight) of approximately 4.4:1; consequently, in the bordeaux mixtures in use in which the proportions are more nearly in the proportion of 1:1 (by weight) or greater, it is evident the final product would consist of this copper hydroxide, calcium sulphate (formed as a result of combination between the copper sulphate and the calcium hydroxide), calcium hydroxide, and a small amount of calcium carbonate.

It is not unusual for authors to refer to different bordeaux sprays as being acid, neutral, or alkaline. That these are misleading terms is evidenced by the fact that an acid bordeaux would necessarily be one in which insufficient lime had been added to precipitate the copper sulphate completely (since this salt gives a slightly acid reaction when in solution in water), requiring proportions of copper sulphate to lime in excess of 6:1 (by weight); a neutral bordeaux could be prepared only when complete precipitation had taken place, requiring proportions of from 6:1 to 4.4:1; and an alkaline bordeaux when lime in any excess of this 4.4:1

proportion was used. It is evident, therefore, that bordeaux mixtures in commercial use are strongly alkaline, owing to the considerable excess of lime which is added beyond the quantity necessary to bring about the formation of cupric hydroxide. Consequently it would appear that tests recommended for the determination of acidity or neutrality are valueless unless applied to sprays based on these 6:1 to 4.4:1 proportions, which are not found in practice to-day.

A discussion on the preparation of bordeaux mixture is necessarily complicated, in that the chemical and physical properties of the mixture are affected by many factors, such as the type of lime used, proportions of materials, and the manner in which the constituents are combined. These factors are discussed in the following sections, since all have a direct bearing on the value of this spray as a fungicide.

TYPES OF BORDEAUX MIXTURES.

The copper salt used in the preparation of bordeaux mixture is invariably in the form of the soluble copper sulphate; but the lime used may be in the form of a solution (lime water), as quicklime, or as commercial hydrated lime.

(1) *Lime Water Bordeaux*.—About forty-five years ago lime water bordeaux was used on a commercial scale to a limited extent, principally in Italy, but did not come into general use largely owing to the fact that the solubility of lime is so low that it is not easy to prepare a mixture (in the proportions by weight of 1-1) with a content greater than about 2 lb. of copper sulphate to 100 gallons of water. An increase in the copper content is possible by using the proportions of 4:1, but this produces a spray in which the available copper is high, and as a result injury would follow its application to other than dormant trees. Furthermore, the precipitate formed is dense and difficult to pass through the spray pump. For these reasons the use of lime water bordeaux is now confined to laboratory studies on the chemical and physical properties of different preparations, as it supplies a convenient means of securing a known quantity of lime in solution.

(2) *Quicklime Bordeaux*.—Until recently the lime used in making most bordeaux sprays was in the form of quicklime, a material prepared by burning limestone, which converts it from calcium carbonate (CaCO_3) to calcium oxide (CaO). Before it may be combined with copper sulphate quicklime is slaked with water, which converts it to hydrated lime (calcium hydroxide, $\text{Ca}(\text{OH})_2$) leading to an evolution of heat and an increase in volume. When a quantity of water is added to the product resulting from slaking, so-called milk of lime is produced, which consists of a small amount of lime water (calcium hydroxide in solution), the bulk being particles of hydrated lime, together with a small amount of calcium carbonate, and impurities which may be present in the quicklime. When this is added to a solution of copper sulphate (or *vice versa*), the lime water combines with the former, and additional lime goes into solution, and this process continues until the whole of the copper sulphate has been precipitated. If the spray were prepared so that the proportions by weight of copper sulphate to lime were 4.4:1, the whole of the lime added would go into solution; but if lime is in excess of this proportion (as in most

bordeaux mixtures) the excess remains as particles of the hydrate in the spray, and in this form is deposited upon the tree.

The degree of purity and freshness of the quicklime materially affects the final product, for impurities in the form of sand, magnesium hydroxide, or calcium carbonate will affect directly the proportions, and consequently the final product, unless the lime taken is in excess of that required to bring about the production of copper hydroxide. In most commercial bordeaux mixtures the formulæ recommended are such that lime is present in considerable excess, which safeguards the orchardist against the use of quicklimes of other than very inferior quality. Nevertheless, as the proportions are directly affected by these impurities, it is advisable to use a good-quality quicklime, and to keep it in sealed containers, for exposure to the air leads to conversion to calcium carbonate, the solubility of which is so low (about 1 lb. being soluble in 10,000 gallons of water) that it is practically worthless for the preparation of this spray.

The proportions may be altered likewise by faulty slaking of the quicklime, for unless this is carried out satisfactorily "drowning" may result, the consequence of which is that a large proportion of the lime remains in lump form and as a result is discarded. To obviate this difficulty, the following procedure is recommended, which, although somewhat slower than the usual practice, will lead to the production of a more satisfactory product. Place a given quantity of quicklime in a wooden vessel, a convenient weight being 30 lb. Add one-third of its weight of water (thus for 30 lb. of quicklime take 1 gallon of water), and wait until the lime breaks down to form a fine powder. To this may then be added 30 gallons of water, which will produce a stock solution of milk of lime, each gallon (when stirred well) containing 1 lb. of lime.

(3) *Hydrated Lime Bordeaux*.—It has been indicated that the object of slaking quicklime is to produce hydrated lime. As Goodwin and Martin (1927) have shown, it is possible to avoid the labour of slaking by using as a lime source prepared hydrated lime. The type recommended is the commercial article which, if properly prepared, is in the form of a fine powder practically free from lumps and impurities, and containing a calcium hydroxide content of at least 90 per cent. The advantages of using the commercial product are that the necessity for slaking is avoided, with its consequent waste of time and material, as the orchardist has but to weigh out a given quantity, mix with water to form a thin paste, and add to the spray tank; and that the particles are in an extremely fine state of division, a factor which materially affects the physical qualities of the spray.

Hydrated lime should be stored in a dry place, since it is prone to cake if exposed to undue moisture, and be kept where possible in sealed containers, since on exposure to the air it reverts slowly to the form of carbonate. Reversion is slow, however, for we have found that a good-quality material contained but 10 per cent. of carbonate when stored for six months in open 4-gallon petrol-tins.

(4) *"Instant" Bordeaux*.—During the past three seasons Schneiderhan (1929, 1932) tested out in West Virginia an improved process for the preparation of bordeaux mixture, which still further simplifies the preparation of this valuable fungicide. In the preparation of this type of bordeaux, which he termed "instant" bordeaux, the same

ingredients are used, but with the differences that both lime and copper sulphate are in powdered form, the lime being the commercial hydrate discussed above, the copper sulphate being in the form of "snow," due to the crystals being powdered by crushing so as to resemble granulated sugar.

In preparing this spray the tank is one-quarter filled with water, the agitator is set running, and a given quantity of the powdered copper sulphate is either poured slowly into the tank, or placed upon the strainer covering the intake so that the incoming stream of water carries the particles into the tank. With the agitator still running, the tank is filled to the three-quarters mark (during this time, if in excess of two minutes, the copper sulphate will have become dissolved), and the requisite amount of lime is then added, after being mixed with water into a thin paste. The tank is then filled, the agitator being run meanwhile, and after a few minutes of continuous agitation the spray is ready to apply.

The advantages of such a process are obvious, since both time and labour are saved; the disadvantages are confined to the difficulty of securing the type of materials necessary.

PREPARATION OF BORDEAUX MIXTURE.

Methods of mixing the Ingredients.—Pickering (1907), Butler (1914), and others recorded that the physical properties of a bordeaux spray were affected by the methods employed in mixing the solutions of copper sulphate and lime, and played an important part in affecting its adhesiveness and therefore its ability to form an effective protective cover. There are no less than nine possible methods of mixing these ingredients—namely, by pouring—

- 1) Concentrated copper solution into diluted lime solution.
- 2) Concentrated copper solution into concentrated lime solution.
- 3) Diluted copper solution into diluted lime solution.
- 4) Diluted copper solution into concentrated lime solution.
- 5) Equal dilutions of both simultaneously into a third vessel.
- 6) Concentrated lime solution into diluted copper solution.
- 7) Concentrated lime solution into concentrated copper solution.
- 8) Diluted lime solution into diluted copper solution.
- 9) Diluted lime solution into concentrated copper solution.

By using the rate of settling or voluminousness of the precipitate as units of measurement (rapid settlement or a precipitate of relatively small volume being considered as indicating an inferior product), these workers have attempted to determine the most efficient of the methods outlined. Pickering (1907) recommended that the spray be prepared by adding a solution of concentrated copper sulphate to the diluted lime (method No. 1); Butler (1914), and Holland, Dunbar, and Gilligan (1927) considered that the best results were secured when the diluted copper solution was added to the concentrated lime (No. 4); and Schneiderhan (1932), as we have seen, recommended the addition of the concentrated lime to the diluted copper sulphate (No. 6) in the preparation of "instant" bordeaux. Bedford and Pickering (1919) condemned the practice of pouring concentrated solutions simultaneously into a third vessel;

Butler (1914) stated that methods Nos. 1, 2, and 7 gave unsatisfactory results; and Holland, Dunbar, and Gilligan, (1927) considered poor results were secured by using method No. 9.

These differences of opinion (especially as there is little definite evidence showing that bordeaux mixtures prepared by many of the methods condemned are inferior as fungicides) suggest that physical properties as measured by the criteria employed may not be as significant as has been indicated. This opinion is strengthened by the statement of Martin (1932) to the effect that the excellent adhesive properties of bordeaux mixtures are due to the fact that the bordeaux precipitate is formed on the tree subsequent to the deposition thereon of the copper-lime precipitate, by the action primarily of the carbon dioxide of the atmosphere.

In our experiments we have secured excellent results with hydrated lime bordeaux mixtures prepared by adding the concentrated lime to the diluted copper sulphate solution (method No. 6). This is a convenient method, and one which enables the spray to be prepared with a minimum of time and labour, and has the added advantage that it may be used in the preparation of "instant" bordeaux without alteration of procedure.

Quality of the Materials.—As the quality of the spray is affected by the quality of the ingredients the orchardist should use the best materials procurable. Copper sulphate should be of a reputable brand, guaranteed to possess a copper sulphate content of 98 per cent. Quicklime should have a low magnesium content, and be reasonably free from earth and sand, since these impurities are apt to damage the linings of the sprayer cylinders, and rapidly wear the disks of the nozzles. A good quality hydrated lime should be practically free from impurities, such as sand or earth, should be fresh, and sold in containers which exclude air and moisture. The particles should be in an extremely fine state of division, a good-quality article being one in which 95 per cent. of the material will pass a 300-mesh sieve, or in which 90 per cent. will remain in suspension for upwards of three hours (Holland, Dunbar, and Gilligan, 1927).

Although it is possible to determine the quality of the materials from which bordeaux mixture is prepared, it is not possible by any known method to determine a factor by which the quality of the spray itself may be measured. Consequently, in the regulations applying to the Fungicides and Insecticides Act of 1927, it is possible to safeguard the orchardist only in so far as concerns the quality of the copper sulphate and lime. If he chooses quality products, and prepares his spray as recommended, and from the proportions specified, he will be assured of a satisfactory bordeaux spray.

Commercial Bordeaux Preparations.—Certain mixtures of lime and copper sulphate, in powder or paste form, have been placed upon this market as commercial bordeaux mixtures. In practice these have proved decidedly inferior and much more expensive than sprays prepared by the orchardist. In the United States, where several such are offered for sale, it is not unusual to attempt the assessment of their value by qualitative determinations of their copper content. Consideration will show that this unit of measurement is unreliable, since it is not the copper content alone that determines

the worth of a bordeaux, but the manner of its preparation, the proportions of copper sulphate to lime used, and the availability of the copper, as has been shown by Bedford and Pickering (1919). As no practical unit of measurement exists it is evident that use of these preparations is hazardous, consequently the safe attitude to adopt is to avoid products of this type.

Formulæ for Preparation of Bordeaux.—Since bordeaux sprays were first introduced into the Dominion it has been customary to indicate the quantities of ingredients in the form of a formula in which materials are arranged in the order of copper sulphate, lime, and water. Thus to prepare the formula 5-4-50, 5 lb. of copper sulphate and 4 lb. of lime are added to 50 gallons of water. In Europe, however, quantities are expressed in percentages; for example, the same formula would be said to contain 1 per cent. copper sulphate and 0.8 per cent. lime. This is understandable if the formula given is arranged proportionately as 5:4:500, since 1 gallon of water weighs 10 lb. Although the percentage method is the more exact, the formula is the simpler method of expressing quantities, provided it is understood that the ingredients are not given in the same units of measurement.

Since the introduction of bordeaux mixture the formulæ used in its preparation have undergone numerous modifications. The first bordeaux sprays were based on formulæ of approximately 15-5-50, in which about three times as much copper sulphate as lime was used. Gradually these proportions were altered, leading to the introduction of the "equal" types of bordeaux, in which approximately the same quantities of copper sulphate and lime were used. An example in point is the 10-10-40 formula in general use some years ago. Then came the tendency to reduce the quantities of copper sulphate and lime in relation to the quantity of water, since it was found that the older preparations were unnecessarily concentrated. Sprays of to-day are based on these modified "equal" formulæ, an example being the well-known 4-4-40. Finally there has been a tendency, particularly in America, to decrease still further the copper sulphate, and increase materially the lime, with a view to enabling this spray to be used on apple-trees during the summer months. An example of such a type is the 2-10-40 bordeaux introduced into Nelson during the 1920-22 seasons.

In New Zealand the formulæ have gone through corresponding changes (the influence doubtless of recommendations being adapted from overseas publications of each current period), as is shown in the following examples: 3-3-50 (Hanlon, 1892); 6-4-22 (Kirk, 1896); 10-10-40, 4-4-40 (Kirk, 1898); 6-4-40 (Kirk, 1905); 8-6-40, 6-4-50, 4-5-50 (Dept. Agric. Bull. 57, 1918); 2-10-40 (spray used in Nelson 1920-22); 5-4-50, 3-4-50 (Cunningham, 1925).

Our experiences during the past three seasons have shown that the heavy applications of former years (10-10-40, 8-6-40) are unnecessary, and that excellent results have been secured with the 5-4-50 formula for winter applications and 3-4-50 for summer use. Consequently these are recommended until further experimental work under New Zealand conditions justify their modification. Details as to the times of application and diseases against which these sprays are applied will appear in the next article of this series.

(To be continued.)

INVESTIGATIONS IN PASTURE PRODUCTION.

III. EXPERIMENT AT MARTON TO COMPARE DIFFERENT FREQUENCIES OF APPLICATION OF SUPERPHOSPHATE ON YIELD AND CHEMICAL COMPOSITION OF PASTURE HERBAGE.

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As a full account of this investigation has just been published as Part 3 of Bulletin No. 31 of the Department of Scientific and Industrial Research, a summary embodying the main features is all that will be presented in this article.

The object of the investigation was to determine the effect on total production, and on production at various times of the year, of applying superphosphate as heavy dressings at long intervals, compared with lighter but more frequent dressings. The treatments were arranged so that each (with one exception) would receive 8 cwt. of superphosphate over a period of two years.

The treatments per acre under trial were as follows:—

- (1) No phosphate.
- (2) Superphosphate (44-46 per cent. tricalcic phosphate), 8 cwt. once in two years.
- (3) Superphosphate, 4 cwt. once a year.
- (4) Superphosphate, 2 cwt. twice a year.
- (5) Superphosphate, $1\frac{1}{2}$ cwt. three times a year.
- (6) Superphosphate, 4 cwt. at commencement of experiment followed by $1\frac{1}{2}$ cwt. as for Treatment 5.

Treatment 6 thus actually received $10\frac{2}{3}$ cwt., compared with 8 cwt. for the other phosphate treatments over the two years. All plots received lime at the commencement of the trial and a dressing of potash each year to ensure lack of these not being limiting factors.

The pasture under trial was a good one of rye-grass and white clover. The technique adopted has been fully described in this *Journal* for August, 1931, page 88.

The present report covers the first two years of the trial from August, 1929, to August, 1931.

The heavy applications made at the commencement (Treatments 2, 3, and 6) gave the best results in the first year, as might be expected. Over the two-year period, however, the application made twice and three times a year (Treatments 4 and 5) gave much better results than the 8 cwt. applied at the beginning (Treatment 2), and slightly better results than Treatment 3, which received one application of 4 cwt. per annum. (Treatment 6, which received more super than any of the others, actually gave the highest production.)

Treatments receiving two or three applications a year gave a better production during the low-production period covered by the late summer, autumn, and winter period, confirming in this respect the results of an investigation reported on in the *Journal* for November, 1931, page 311. In addition to this, the applications made two or three times

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a year gave a greater proportion of their production during the low-production period than did "no phosphate" or Treatments 2 and 3. The result of this was that the difference, as a percentage of the total production, between the highest and lowest production periods was reduced.

In the second season the highest-yielding treatment produced 8,506 lb. of dry matter per acre, which is about equal to a 34-ton per acre crop of swedes.

Sixteen months from the commencement of the trial Treatments 4 and 5, which had then received 6 cwt. and $5\frac{1}{2}$ cwt. of super respectively, had produced slightly more total herbage than Treatment 2, which had received 8 cwt. in one dressing.

During the whole of the second year the herbage from Treatments 1, 2, 3, and 6 was submitted to chemical analysis. The application three times a year in Treatment 6 kept the phosphate, lime, and protein content of the herbage at a more uniform level throughout the year than did less frequent applications. The beneficial effect in keeping the phosphate content up to a higher level during dry weather, when herbage is normally low in phosphate, is undoubtedly an important feature of summer dressings. All phosphate treatments increased the phosphate, lime, and protein content of the herbage over that of the "no phosphate" for the year as a whole.

The experiment is being continued, and the future results should be more informative than those for the first two years. The heavy applications made at the commencement had an initial advantage over those applied in smaller dressings more frequently. At the end of the two years, however, the more frequent applications had a decidedly favourable balance of phosphate, as was indicated by their higher production at this time, and they should show a greater superiority, at least over the dressing made once in two years, than was the case in the first two-year period.

DISCOLORATION IN CHEESE.

G. M. MOIR, Dairy Chemist, Wallaceville Laboratory.

AT the Wallaceville Laboratory the subject of discoloration in cheese has been investigated for some time by Mr. G. F. V. Morgan, Dairy Bacteriologist, with whom the writer has recently been associated. The investigations have conclusively shown that pink, bleached, and muddy or dark discoloration are due to the entry of air and mould growth from the rind subsequent to manufacture. Mould confined to the surface of the rind can scarcely be avoided and usually does little harm, but it can do serious damage whenever it penetrates the body of the cheese. This has been repeatedly observed to occur in two ways, (1) through badly sealed trier holes, (2) through cracked rinds.

To eliminate the first cause preventive measures were taken some time ago by using melted paraffin wax to seal trier holes made at the grading stores. If the same precautions were regularly adopted in the factories the unsightly appearance of mould within the cheese, and the associated losses, could be still further diminished.

The second means of admission of moulds to the body of the cheese—through cracked rinds—can be minimized by careful handling. By taking every care to make cheese with good rinds, and by further application of the steps already found useful to seal trier holes, complaints of losses due to discoloured cheese should become a thing of the past.

CONDITIONS OF MOULD GROWTH.

Experiments have recently been carried out which have shown that in their early stages of growth moulds are able to produce acid conditions, especially if the supply of oxygen is very limited. At a later stage, if more oxygen is supplied, the moulds soon begin to produce alkali. These experiments represent a notable advance, for they show that mould, which usually in a mature stage produces the more alkaline conditions frequently found in discoloured portions of cheese, can, under special abnormal conditions, produce appreciable amounts of acid.

COD-LIVER OIL FOR BROODER CHICKS.

EXPERIMENT AT WALLACEVILLE POULTRY STATION.

H. A. KITTO, Overseer, Wallaceville Poultry Station.

For some considerable time past the use of cod-liver oil as a food for poultry has been advocated in various parts of the world. It is only recently, however, that its use has received much attention from poultry-keepers in New Zealand. As is commonly the case with most new things advocated for feeding poultry, there is a wide difference of opinion among those who have included this material in the ration for their fowls regarding its value as a food from an economic standpoint when fed to birds of any age. It is probable, however, that few, if any, poultry-keepers who have used it in this country had any control fowls with which results could be compared between birds fed with and those without the cod-liver oil. Therefore in the absence of reliable data the extent to which this material can be profitably included in a ration for poultry is somewhat problematical, so far as our present local experience with it is concerned, and probably such will continue to be the case until we have the results of further practical experience to guide us.

In an endeavour to gain some first-hand data in regard to feeding cod-liver oil to poultry, some investigational work was carried out at the Wallaceville Poultry Station during the past year. The first experiment commenced on 17th August, and terminated on 13th November last. In this experiment 162 chicks took part. These were taken direct from an incubator and placed under a canopy style of brooder, heated by means of electricity. The brooder and also the room in which it was installed were divided in the centre by light wooden frames covered with small-mesh wire netting. The 162 chicks were equally divided and placed on each side of the brooder, so that the conditions provided for each lot of chicks were similar in all respects. From the outset both lots of chicks received a similar food ration, excepting that one lot had cod-liver oil added to the mash mixture once a day.

This was given at the rate of $\frac{1}{4}$ oz. for the first ten days, and $\frac{1}{2}$ oz. for the following thirty-two days, and from then onward to the termination of the test 1 oz. of oil was fed daily.

It has been claimed that the addition of cod-liver oil to the ration for young chicks will have the effect of promoting vigorous development, increased bodily weight, and a minimum death-rate; therefore the chief object aimed at in this experiment was to determine as far as possible to what degree, if any, the oil-fed birds would increase their weight, vigour, &c., as compared with the control birds which did not receive oil. Each lot of chicks was carefully weighed collectively before being placed under the brooder, and at weekly periods during the progress of the test. The accompanying table shows the results of the different weighings.

Both lots of chicks were practically of the same weight when placed under the brooder. Unfortunately, six deaths occurred during the test—two of the oil-fed birds and four of the controls. To a certain extent this detracted from the value of the experiment; nevertheless a study of the figures contained in the table gives sufficient indication that the cod-liver oil had little if any influence in increasing the weight of the chicks to which it was fed, while at no stage of the test was there any observable difference in general appearance between the two lots of chicks. This applied not only to the observations of those directly interested in the experiment, but to visitors as well. The feathers on the heads of the oil-fed birds were marked with indelible pencil, which naturally attracted the attention of many visitors, and inquiries were made regarding the purpose of the mark. Usually before satisfying inquirers on this point the question was asked as to which lot of chicks they considered looked the better. In some cases the oil-fed birds were selected, and in others the controls, which goes to show that there was nothing outstanding in the general appearance of the oil-fed birds.

Table showing Periodical Weighings of Chicks in Experiment.

Date of Weighing.			Oil-fed Chicks.		Control Chicks.	
			Weight.	Number.	Weight.	Number.
			lb.	oz.	lb.	oz.
August 17th	..	..	8	9 $\frac{3}{4}$	8	8 $\frac{1}{4}$
" 24th	..	..	11	13 $\frac{1}{2}$	11	14 $\frac{1}{4}$
" 31st	..	..	25	2 $\frac{1}{4}$	25	6 $\frac{3}{4}$
September 7th	..	..	38	8 $\frac{3}{4}$	39	0
" 14th	..	..	39	9 $\frac{1}{2}$	39	7 $\frac{1}{4}$
" 21st	..	..	49	12	51	13 $\frac{1}{2}$
" 28th	..	..	60	15	65	4
October 5th	..	..	73	8 $\frac{1}{2}$	73	9 $\frac{1}{4}$
" 12th	..	..	86	8	83	0
" 19th	..	..	106	4	102	12
" 26th	..	..	125	8	122	0
November 2nd	..	..	145	12	142	4
" 9th	..	..	169	0	164	12

A similar experiment will be carried out during the forthcoming hatching and rearing season.

CATTLE-LICK CONTAINER FROM OLD MILK-CAN.

MR. H. R. Denize, Inspector of Stock, Hawera, forwards particulars of an economical cattle-lick container devised by Mr. R. A. Anstis, Normanby, and in use on his farm, as shown in the accompanying photograph. Directions for making and erecting are given as follows :—

Use an old 20-gallon milk-can. Cut out a piece from the side measuring 20 in. by 22 in., leaving about 6 in. at the bottom end of the can and about 3 in. at the lid end. Drill a $\frac{1}{2}$ -in. hole through the centre band round the can directly opposite the centre of the aperture. Fix the lid securely



in position. To erect, turn the can up-side-down, and bolt it to a substantial and sound post with a clearance of about 1 ft. from the ground, facing the can in such a direction that the prevailing winds will not blow rain into it. To prevent the can from swinging about on the bolt, either hollow out the face of the post or nail a batten down each side of the post close against the can. A thin layer of cement concrete on the top and in the lid will make the can rust-proof and rain-proof.

Dairy-cow Hygiene.—Apart from the sanitation of the milking-shed itself, improved hygienic handling of dairy cows is very desirable—in fact, more than ever necessary to-day when the production of clean milk is being so strongly advocated. Furthermore, the practice of cow hygiene materially tends to lessen the incidence of such diseases as mammitis, abortion, foul-foot, &c. The hygiene of the dairy cow may be said to begin with the yards. Dirty, muddy yards lead to the accumulation of dirt on the udders and legs of the cow before she enters the shed. Yards should be concreted, or at least metalled, so as to provide a surface readily cleaned. Strict attention should be paid to the cleansing of the teats and udder before milking. Accumulation of filth on the cows' tails is a source of milk-contamination. Leg-ropes need special mention; the rope is handled by the milker immediately before he proceeds to milk, and is frequently septic. Stools, and the handles releasing the shed-doors should be washed daily. In dry dusty weather the flanks and quarters of the cow should be cleaned before milking begins. Cows with uterine discharge or retained afterbirth should not be allowed into the shed, but isolated and suitably treated.

SEASONAL NOTES.

THE FARM.

Breaking-up of Pasture.

A MOST important matter that many farmers will have occasion to consider at this time of the year is the amount and location of the grassland it is advisable to put under the plough during the coming season. This matter usually needs to be considered from several aspects. Firstly, it is necessary to take into account what area of special crops—such as mangels, swedes, turnips, and chou mœllier—should be grown to ensure adequate provision of feed for the critical periods when the feed available from grassland is likely to be below the current requirement of stock. Of some significance in this connection is the fact that generally the provision made for the critical seasons is inadequate—sometimes markedly inadequate—and that especially in dairying, but also in sheep-farming, there would frequently be more profitable returns were the plough more freely used as a step towards better feeding during those periods when the growth on pastures is commonly scant.

Secondly, the ploughing-down of many pastures is called for because of their inferior swards. In some cases such pastures may consist of plants generally inferior to those which the land is fitted to support advantageously when due regard is given to the possibility of reinforcing natural fertility by judicious top-dressing. For instance, pastures which are dominantly weeds, brown-top, or dogstail may be found occupying ground which could profitably support rye-grass, white clover, and cocksfoot, especially if given reasonable assistance in the form of phosphatic top-dressing and efficient grazing management. In other cases, because of the use of inferior types of seed, incorrectly reputed to be of perennial character, or because of the ravages of the grass-grub, pastures may consist of plants so few in number as to warrant ploughing as a first step towards replacement of the open swards with ones of greater density.

With some justification, based on past experience, farmers at times hesitate to plough up pastures which they believe are not of as high a standard as could reasonably be expected in the circumstances. Underlying such an attitude is usually a doubt as to whether it is possible to replace the present pastures by ones which will continue to be superior to them for a period long enough to make the venture a profitable one. The doubt which operates in such cases originates almost invariably in disappointing past experience, in which the use of inferior strains of pasture species led to rapid falling-off in production of relatively young pastures. All doubt of this nature is unjustified in the light of the present knowledge of strain differences in important pasture species, of which perennial rye-grass is of most current moment. We now know not only that at times newly sown pastures fell away in a disappointing manner but also why this occurred, and fortunately the knowledge of why it occurred is supplemented by the knowledge of how to avoid such regrettable falling-off.

In brief, it has been demonstrated that lines of seed commercially known as "perennial" rye-grass fell broadly into two main classes, (1) true perennial, (2) false perennial, which at times proves less persistent and less valuable than ordinary Italian rye-grass. This latter undesirable type was commonly used in the sowing of pastures which were desired to be of as permanent a character as possible. Even on land of relatively high fertility such inferior rye-grass incorrectly reputed to be of a perennial nature disappeared from the sward in a comparatively short time, thereby

making an opening for the entrance of inferior plant species, the ultimate result being that the young pasture tended quickly to descend to the low standard of the one which it replaced. The use of the true perennial type of rye-grass would obviate such falling-off in pastures.

The fact that the official system of seed certification assures a reliable supply of the desirable strains of pasture plants has within recent years intensified the case for the breaking-up of worn-out pastures, which at times have been retained mainly because of uncertainty, the real justification of which has now been largely removed. While strain differences are of paramount importance in the case of rye-grass, they are of considerable, even if not of equal, importance in the case of white clover and cocksfoot. The position is summed up in the fact that the possibility of using improved strains of pasture plants is a direct and weighty incentive to the replacement of somewhat inferior pastures by the best possible swards which will respond more profitably to good pasture-management, practices such as top-dressing, and efficient grazing management.

A third matter bearing on the breaking-up of pastures is the role of top-dressing. By top-dressing farmers have often been able to achieve such great results that they have inclined at times to rely on it overmuch. Certain pastures have been improved strikingly by top-dressing, and from this it has been deduced that all pastures could be similarly improved. This is not always so, but, even if it were, it does not necessarily follow that top-dressing is the most economical means of improving the composition of pastures. It is quite conceivable that the improvement which could be effected in a short time by breaking up and renewal would take so long to achieve by top-dressing as to make the breaking-up and resowing the more desirable method, despite the fact that it involves the greater immediate expense.

Further, it is overlooked at times that on certain swards top-dressing, even if it is as judiciously done as possible, can reasonably be expected to bring about only a very limited amount of improvement; if a sward is devoid of superior species such as rye-grass, white clover, and cocksfoot, the influence of top-dressing is necessarily limited to the inferior plants which are present, and is unlikely to bring about any marked changes in sward composition. In such cases the standard method of obtaining an improved sward is ploughing and reseedling.

In some instances this standard method, because of labour, cost, or other considerations, may not be practicable. In such cases it may be advisable to endeavour to bring about sward renovation by surface sowing of seed. It is well to keep in mind that surface sowing is associated with risks arising mainly from weather conditions, and is not always successful. Hence, if at all practicable, the sowing of pasture seeds on a ploughed and cultivated surface should be practised.

The position summed up is that during recent years the breaking-up of inferior pastures has not proceeded as fast as it profitably could have done. At times there has been too great a tendency to effect pasture improvement by slower and at times uncertain methods, such as top-dressing and surface sowing of seed. From the pasture viewpoint alone, on many farms, a greater amount of ploughing would be well justified, and, in addition, ploughing, resulting in greater amounts of supplementary crops, would tend to materially and profitably improve the feeding of our live-stock.

Pasture Top-dressing, &c.

Much useful top-dressing may be done in July and August, and at this stage it would probably be very advisable on the part of those whose top-dressing programme has as yet this year been restricted. The use of super-phosphate at this season may generally be recommended. Farmers who are faced with the prospect of an acute shortage of feed during August and

September may well give consideration to the use in late July or August of sulphate of ammonia or analagous nitrogenous manures, which in such circumstances tend to be profitable as a means of securing additional early season feed. As a rule these nitrogenous manures should be accompanied by the use of superphosphate or other phosphates, unless phosphates were applied to the pastures at a date not far distant. In this connection the use of ammoniated superphosphate avoids the necessity of handling separately the nitrogenous and phosphatic materials. Pastures that are to be dressed at this season with nitrogenous material should preferably be well-drained ones containing rye-grass as a prominent constituent. In addition, prior to the application of the top-dressing, they should be eaten back so that all coarse dry herbage is removed as completely as possible, and generally they should be harrowed immediately before or after the fertilizer is applied.

Last month's notes relative to grassland work, including ensilage, are applicable in the main to the July-August operations on farms.

General Cropping Work.

Especially in the South Island, cultivation work should be pushed ahead with the utmost expedition whenever the soil is dry enough to allow of working it without doing harm. The speeding of the plough and other implements is specially desirable in the preparatory work for cereal crops, but it is similarly, even though not equally, advisable in preparation of such crops as lucerne, mangels, and potatoes. When old swards are being broken up for these crops it is often advisable to fit a skimming attachment to the plough, in order to effect a complete burial of the surface layer with its complement of weeds.

As already suggested, cultivation work for cereals should generally take precedence over all other team work. From experience it has become customary to sow the bulk of the spring wheat crop in August and early September. The sowing of oats should, as a rule, be proceeded with as soon as the wheat sowing has been effected. Black Skinless barley may often be sown advantageously in August.

In the spring sowing of cereals a greater amount of seed is usually used than in the autumn sowing. For example, a sowing of 2 bushels of Tuscan wheat is favoured in spring, in comparison with $1\frac{1}{2}$ and $1\frac{3}{4}$ bushels per acre in autumn.

Autumn-sown cereals, if they are to be allowed to develop into a chaff or grain crop, should be given a final grazing about the end of August. However, if lodging of the crop is anticipated on account of the high fertility of the land, then the final feeding-off may well take place in September. Generally after the final feeding-off of cereals the crops may advantageously be tine-harrowed—this serves to loosen the trampled surface and to break up and scatter droppings. Feeding-off of cereals in the spring should be done by heavily stocking the area for a short period, and this preferably when the soil is as dry as possible. Harrowing of autumn-sown wheat, if it is somewhat thin, is often advantageous even if the crop has not been eaten off, for the harrowing tends to increase the amount of tillering, which thickens the crop.

Seed treatment for the control of disease is just as advisable in the case of spring-sown as it is in the case of autumn-sown cereals. Further, the seed of oats and barley calls for treatment just as does seed wheat. It is sometimes advanced as an excuse for not treating seed oats that the crop will not be harvested for grain. This excuse overlooks the fact that chaff from a smutted crop is of less value than chaff from a similar crop free from smut. The copper carbonate treatment is recommended for seed wheat, with the formalin treatment as an alternative. For oats and barley the formalin treatment is recommended. Details of both treatments may be obtained from local officers of the Fields Division.

Winter Feeding.

Every possible endeavour should be made to bring about the adequate feeding in July and August of dairy-cows and breeding-ewes. Because of the unusually marked shortage of feed this year it may prove advisable for some farmers to supplement their supplies of silage, hay, and roots by purchased feeds such as bran and meals.

If sheep which are to be fed silage have not consumed it previously, then the silage should be introduced into their winter rations before they have become markedly low in condition. Sometimes sheep start to eat silage only when they have been reduced to a hungry condition, and it is preferable to subject them to a period of hunger while they are still in relatively good condition. Two to three pounds a head daily of silage is a substantial contribution to a sheep's requirements, while 5 lb. a head daily suffices for complete maintenance.

Other aspects of crop production and crop utilization which are of importance at this season were discussed in last month's Farm Notes.

—R. P. Connell, Field Division, Palmerston North.

THE ORCHARD.

Spring Spraying of Stone Fruits.

WITH the commencement of the spraying season, it should be distinctly understood that no recommendations in these or any other notes can be effective unless the programme outlined is consistently and completely carried out to schedule. The strengths advocated and the times of application must be strictly adhered to, and the ingredients accurately weighed or measured with standard weights and measures. The guessing of weights and the use of tobacco tins for measuring have been costly to many growers. Neither can any programme be effective unless the applications are thorough. Once the spray plant is working the little extra time and material required to adequately cover every portion of every tree are a mere bagatelle compared with the results obtained. The average man at the nozzle does *not* give an effective cover to the trees, and it is astounding the amount that is left unsprayed by many who are looked upon as careful sprayers and who feel that they are doing the work well.

Leaf-curl, Die-back, Rust, Brown-rot, Shothole, Bladder Plum, &c.—With varieties of peaches and nectarines that are very subject to leaf-curl, with apricots that are susceptible to shothole, and in districts where the other diseases are troublesome, two applications of a fungicide are advisable prior to blossoming. The first should be applied at, or just prior to, the first movement shown of the terminal wood buds on the laterals, and the second when most of the wood buds are showing a definite move; some ten days before the first indication of "pink" in the most advanced blossom buds. If an autumn fungicide has been applied the first of these applications can be omitted. With the varieties less susceptible to curl and shothole, and in localities moderately free from the other diseases, one pre-blossom application will be found sufficient—namely, at early movement of wood buds.

The sprays recommended are bordeaux mixture 5-4-50 (bluestone 5 lb., quicklime 4 lb., water 50 gallons), or burgundy mixture 5-5-50 (bluestone 5 lb., washing soda 5 lb., water 50 gallons). A number of growers who last season tried bordeaux made with hydrated lime had satisfactory results. The strength used was $3\frac{1}{2}$ 2-50 (bluestone $3\frac{1}{2}$ lb., hydrated lime 2 lb., water 50 gallons).

Lime-sulphur, while effective for some of the above-mentioned diseases, has not proved itself satisfactory for the control of leaf-curl, neither has

it yet proved itself an effective controllant of shothole of the apricot. Those who desire to use lime-sulphur should consult the table of dilutions compiled by Dr. G. H. Cunningham which appeared on page 265 of the April issue of this *Journal*.

The Orchardist's Nursery.

In the April issue of the *Journal* suggestions were made for the establishment of an orchardist's nursery. Where stocks have been procured they should be planted in the nursery in rows 2 ft. apart and 1 ft. between the trees in the row. This should be done as soon as the soil is in good condition and the weather permits. The roots should be carefully pruned, cutting off any that are broken or damaged, and cutting back the top to, say, 1 ft. from ground-level. Care must be taken to avoid any possibility of drying out before planting, otherwise commencement of growth will be delayed. For the same reason planting should be done firmly, treading the soil well down on the roots, and leaving it loose on the very top. Most of these stocks should be ready for budding next autumn.

The soil where cuttings were planted in the autumn requires to be kept stirred and free from weeds by light hoeing and hand weeding; deep working must be avoided, as injury may result to the roots.

Stones or pits of plums, peaches, and apricots will require attention as soon as the ground is in fit condition and has been worked up into a fine tilth. Plum stones should be sown in drills 12 in. to 18 in. apart and about 3 in. deep, after which the ground is well firmed by treading as is done with peas and beans. It is unlikely that the resultant trees will be ready for budding next autumn, they can therefore be sown fairly closely in the drills, for they will be raised and transplanted into proper nursery rows next season.

Many of the peach and nectarine pits sown this spring will be large enough to bud next summer, consequently they are treated in a somewhat different manner to plums. The pits are usually sown shallow and close together in beds or drills in well-worked soil in which for preference a fair amount of sand has been incorporated. As soon as they have sprouted through the ground and are large enough to handle they can be carefully transplanted with a garden trowel into nursery rows 1 ft. apart between the plants and 2 ft. between the rows. Peach pits may also be sown thickly in the nursery row about 3 in. deep and thinned out to 1 ft. apart when large enough to handle, the thinnings again being transplanted into other nursery rows. The former method is preferable. The young seedlings should be transplanted to the same depth as they were in the seed-bed or drill.

The young apricot seedling is slower growing than the peach and in most districts there will be very few ready for budding next autumn; the stones, therefore, may be successfully treated either like the plum or the peach.

Trees that were budded last autumn should be looked over and all growths below the bud removed. Trees on which the buds have taken should be cut back to 3 in. or 4 in. above the bud, and the stub later used for tying to the young growth to prevent wind damage. Those which have been missed can be grafted this spring so as to save a season.

Planting.

Considerable care and attention should be given to planting, as it is anticipated that a tree once planted will be in the ground for many years. In new plantings see that the trees are symmetrically planted, and where replacements are being made that they are in line with other trees in all directions. Trees should be planted as soon as the ground is free from frost, is dry enough, and is in good tilth. Plant to the same

depth as they were in the nursery, as indicated by the soil mark. Lay out the ground first, see that the hole is large enough, that the soil immediately beneath and around the roots is good and in good condition and work a little blood and bone and superphosphate into the soil at the bottom of the hole, but not so that the roots are directly touching the fertilizer. Trim the roots, cutting back any broken or damaged pieces. Place the tree upright in the hole, partly fill with good soil, shake the tree slightly so as to fill in the hollows around the roots, tread firmly, fill the hole almost to the top, tread again, and complete by filling with soil left loose and standing a little above the ground-level.

If the tree is a yearling whip, prune the tree back to a little below knee high; if branched cut away everything except three well-placed branches, and shorten these to three or four buds. If the branches are too weakly, are badly placed, or are too high, cut off all branches and head back to the right level.

Miscellaneous.

Pruning should now be pushed on with the utmost vigour, so that it may be completed before movement commences and to enable growers to proceed with other important work. Prunings should be collected and burned, and large cuts covered with coal tar or paint.

Orchardists who have not yet applied their fertilizers should do so at once. Those intending to give the trees sulphate of ammonia or nitrate of soda should apply the former about green-tip and the latter in the pink stage.

Old trees that were worked over last season should have much of the wood which has come away on the stock removed, and the large cuts sawn carefully at a slant to the graft and painted or tarred. Where there have been misses, appropriately placed young shoots should be left untouched now and whip-grafted in the spring. Those that were budded last autumn should be headed back to within 3 in. or 4 in. of the bud; the young shoots can later be tied to the stub to protect it from wind.

The main working of the ground will be the ploughing in of the cover-crop and weeds. This is better done as soon as possible, so as to allow the material to rot before the dry weather sets in; otherwise the soil will remain puffy and full of hollows underneath, which will cause it to dry out still further.

—W. R. L. Williams, Orchard Instructor, Alexandra.

Citrus Culture.

Where new plantations are being established, or the present ones extended, it is assumed that every effort has been made to bring the soil into a suitable state for the reception of the trees. Planting of any kind is not advisable unless all preliminary work has been carried out. Citrus trees will thrive upon quite a large range of soils, provided the land has been treated in a proper manner. Thorough drainage is essential in all soils and should receive every consideration. Plenty of shelter should also be provided, and if this is not already well established the citrus trees will suffer from being exposed to the strong winds. The ideal for all citrus trees is a moderately rich friable soil having a plentiful supply of organic matter. A northerly aspect is preferable, and a situation that receives an abundance of sunshine and is well sheltered from the west and south-west winds.

If everything is in readiness the trees can be planted out at any time from now on until the end of September, but on no account should planting be done if the soil is very wet. Before planting, any damaged roots should be cut away, and as the tree is placed in the hole already provided some fine soil should be placed around it and trodden firmly. It

is very poor practice to hurry over the planting of any trees. A little extra time and care bestowed at this period is well worth while. After the first soil has been well firmed it is advisable to make an application of some suitable fertilizer, such as blood and bone, or superphosphate, around the outer edge of the hole. About 1 lb. should be sufficient. By distributing it around the outside of the hole it will encourage the young rootlets to work outwards in search of food, and development will take place. The final filling should then be carried out and the top 2 in. of soil left quite loose.

Young well-grown healthy trees planted out under the conditions briefly outlined should come away quickly and establish themselves in such a way as to become in quite a short period profitable commercial plantations. On the other hand, if even some of these conditions are lacking, the trees may be a disappointment and bring discouragement to the grower.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Hatching and Rearing.

AUGUST and September are generally regarded as being the best months of the year for hatching out chickens for the renewal of stock, and therefore every effort should be made to secure the required number of young birds before the end of September, or early in October at the latest. Chickens brought out at a later period seldom prove satisfactory. Indeed, at the current prices for foodstuffs, late-hatched stock may easily show a loss for the season instead of a profit. Apart from laying undersized eggs, the bulk of which are produced during the cheap season, the birds are always more prone to disease and parasitic infestation than those brought out at the right time. Obviously the greater the number of late-hatched birds on the plant, the greater the drain on profits.

Where the natural mothers are depended upon, the question of securing broody hens at this period of the year is frequently found to be a difficult one, especially on plants where none but heavy-producing stock are kept, for as the egg type advances the broody tendency weakens, so that the more profitable the stock from an egg-laying viewpoint the greater the difficulty in obtaining broody hens. The White Leghorn is a case in point, for with the best egg-producing types of this breed the broody propensity has almost disappeared. Even with the noted laying strains of the heavier breeds, such as the Black Orpington, the tendency to broodiness is weakening, and even where in this class of stock broodies may be depended upon, they invariably do not become broody until too late for the hatching of winter layers.

Where the plant is on a small scale, and an incubator is not used, the difficulty is a vital one. There are three alternatives: (1) To keep some poor-laying types of the heavier breeds; (2) to secure day-old chicks and rear them by artificial means; (3) to secure, if possible, eight- to ten-weeks-old pullets. This trade is now being catered for by several specialist breeders, and also by the Department's Wallaceville Poultry Station. In view of the moderate prices at which the young birds are quoted, and having regard to the fact that they are reared beyond the critical stages of their life, and to the reduction of the loss entailed in rearing cockerels to an age when the sexes can be determined, the question of stocking up the plant with young pullets should specially appeal to the farmer and other side-line poultry-keepers.

Brooder Hints.

While the quality and constitution of the breeding-stock determines to a large extent the quality of chicks produced, the production of satisfactory progeny depends on something more than parentage. Chicken-rearing by artificial means is a business of many small details, and if these are not observed in every respect the best chickens ever hatched will fail to thrive or develop into profitable stock.

If success is to be achieved, and the mortality reduced to a minimum, the chicks must be well and carefully handled from the day they leave the shell, and right through all stages of their development. Having a batch of well-hatched good strong chicks, it is of vital importance that the young birds are well dried off before being removed from the incubator to the brooder. To aid this the moisture pans should be removed from the incubator and the ventilators opened wide. As a further means to this end the door of the incubator may be opened, say, about $\frac{1}{4}$ in., just previous to transferring the little birds to the brooder. If chicks are removed from the incubator before they are thoroughly dry they become highly susceptible to chill, and this must be avoided, or mortality is almost sure to follow.

When the chicks are placed under the brooder the next important detail is to provide them with a more or less uniform degree of temperature, but the brooder should be so arranged that the chicks can secure a variation of warmth. In this way they are given an opportunity to move away from the heat when it is excessive, which frequently happens on a hot night. The behaviour of the chicks at night is the best guide as to whether they are comfortable or not. If the chicks are spread out it may be taken for granted that the heat being maintained is correct, but should they appear to be huddling it is an indication that more heat is required. Generally speaking, if given the opportunity, and provided they are not overcrowded, they will secure the degree of warmth that instinct demands.

Where brooders of the canopy type are used, and normal conditions prevail, the chicks should be encouraged to settle down at night around the outside edge of the brooder. In this way the chicks are afforded an opportunity of moving to and from the main source of heat and securing the desired degree of temperature. Even with this class of brooder the chicks will sometimes crowd into corners of the house. The cause of this behaviour is usually put down to excessive heat surrounding the brooder. Generally, however, it is due to a ground draught. Plenty of fresh air is an essential requirement for chickens of any age, but, above all things, it must be provided without draught. If there is a draught from any particular quarter, the chicks will gradually move away from it until the corner is reached, indicating that they prefer to leave the chief source of heat, so essential for their welfare, rather than remain in a draught. If this trouble is to be prevented a draught-break must be arranged surrounding the brooder. Pieces of thin-gauge sheet tin about 15 in. high placed on the floor of the brooder-house will serve the purpose of checking draught, or a less expensive arrangement can be made from cut down petrol-tins joined together with pieces of thin wire.

Chickens should be carefully watched at sunset. It frequently happens that they will settle down on a spot where the sun has last shone on the floor of the brooder-house instead of going under the brooder. Where windows are used in the wall of a brooder house this habit will be checked by white-washing the windows when the chickens are young, or by placing curtains over the open space at the front of the house some time before sunset. In short, every care should be taken to prevent the chicks from huddling, which has the effect of making them susceptible to chill. Once they become affected in this way it is next to useless trying to doctor them; they usually

die in spite of anything that is done for them, and very often it pays to destroy them at the outset. It is safe to assume that more chickens die owing to chills, or fail to reach a proper stage of development through their evil effects, than from all other causes put together. If chickens receive a chill it usually takes about three days before the injurious effects manifest themselves, the most common symptoms being a general tendency to huddling, a distressed chirp, excessive thirst, droopy wings, and no inclination to leave the brooder or to eat. Then follows bowel trouble, and as a result of the huddling the delicate legs become spread, to be followed by an unsteady gait in the walk, and a general unthrifty appearance.

The common causes of chill are irregular temperatures in the brooder-box, overheating, and insufficient ventilation. Removing the chicks too soon from the incubator to the brooder before they are dry, and giving them too much freedom for the first few days, are also causes of chill. Prevention is the only way of dealing with this trouble. The brooder should be so constructed and attended to that extremes of heat and cold may be prevented, at the same time never allowing stuffiness or draughts to exist. More chickens should not be put in the brooder than it is capable of accommodating to the best advantage. Overcrowding is simply courting disaster.

Strict attention to cleanliness is another important matter which must not be overlooked. If the quarters are allowed to become foul and filthy the presence of parasites, lice, mites, and intestinal worm infestation is encouraged, and disease germs also. Before a new hatch of chicks is placed in the brooder the latter should be well cleaned and disinfected.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

First Spring Inspection.

WHENEVER the temperature will allow, advantage may be taken of fine spring days to give the colonies their first inspection of the season. It is highly important that this work should be undertaken early in August, and not postponed until brood-rearing has commenced in earnest. By this time small patches of brood will be found, and under favourable conditions the quantity will rapidly increase, but just in proportion to the amount of food available so will brood-rearing proceed. On no account should the examination be postponed indefinitely if it can be avoided, or in all probability losses will be recorded through starvation. During the dormant season the drain on the stores is small, but once the activities of the hive commence no effort should be spared to see that each individual colony has sufficient food to meet current demands. Colonies containing at this season 15 lb. to 20 lb. of honey may be left undisturbed for some weeks, but failing this amount preparation should be made for feeding.

Supers.—In order to facilitate brood-rearing, supers left on during the winter months may be removed and the bees confined to the brood-chamber. In cases where bees are found in the super, remove the deserted brood-combs and place the super containing the bees on the bottom-board. Make all the hives snug, and provide each with one or two extra mats. These will help to conserve the heat of the hive.

Queen-right Colonies.—As indicated, an important matter in connection with the first examination of colonies is to note the extent of brood-rearing in progress. This will largely determine whether the colony has a laying-queen. Do not hastily conclude that a colony is queenless if brood is not visible, as much depends on the locality and weather conditions preceding

the examination. If the colony is strong and normal the question of queenlessness may be postponed until a later date. Make a note of each hive and its condition for future reference.

Apiary Records.

At every examination the beekeeper should make a record of the condition of his hives with regard to stores, brood, health, and fertility of queen. These records are invaluable, and enable one to proceed about the work systematically. Where time and labour are considerations, notes made at the time of inspection will save confusion and endless trouble. A pencil note on the inside of the cover, or on a piece of section placed under the roof, is handy for reference if by any chance the notebook be mislaid.

Preparations for the New Season.

The beekeeper should as far as possible utilize his spare time in making preparations for the coming season. Generally there is a good deal of work which can be undertaken now. Push on with hive and frame making if increase has been decided upon, and with the overhauling of any faulty supers, roofs, and bottom-boards. Usually when the bees are absorbing the greater part of the beekeeper's attention he will find very little time to attend to the mechanical part of the work. Do not postpone ordering supplies. Beekeepers who are not skilled with tools will find it more profitable to purchase their hives from the manufacturers. The machine-made hives can be depended upon, as they have been brought to a high standard of perfection.

When purchasing new supplies aim at uniformity. Do not be tempted to purchase job lines of bee material because dealers have represented the lines to be cheap. Standardize your hives, and endeavour each season as far as possible to dispense with badly fitting supers, &c. Nothing is more tantalizing than to find that supers will not fit the bottom-boards, or that roofs are an inch or so too long. One cannot afford to neglect the working-plant. Good standard hives are among the essentials that lead to profitable management.

Frame Making and Wiring.

A great deal of time must necessarily be spent performing this very important part of the work. The assembling of brood-frames and extracting-frames should receive every consideration. There are many plans for curtailing the labour involved, but, whatever method is adopted, strict attention must be given to proper nailing. Neglect to secure frames properly will lead to endless worry when the frames are in use. In districts where the bees gather propolis in large quantities too great caution cannot be exercised in nailing. It is not sufficient to drive a nail down through the top bar into the end bar. Too often the top bar will come away and leave the end bars jammed by the pressure of the other frames and adhering propolis. To guard against this trouble, the end bars should be nailed to the top bar by driving two nails through the end bars parallel with and into the top bar. This will secure the frame and prevent it from breaking when in use. On no account dispense with wiring the frames if the combs are to be extracted. Good wiring will enable the beekeeper to handle his combs freely, and even on very hot days there is no risk of their falling from the frames, as is the case when wiring is not adopted. When using full sheets of foundation it is a distinct advantage to employ wire. This holds the foundation in position, and good straight combs are produced. See that the wires are tight and securely fastened. A time-saving method is to cut the wire into lengths of about 60 in., and bind in the centre; the strands can then be pulled out as required.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Tomato Crops, Hotbeds, and Seed-boxes.

THE tomato crop under glass is usually planted out, in the middle districts, towards the end of August. It is important to plant deeply and firmly. While such houses should be aired well at every opportunity in fine warm weather, the ventilators should be closed early in the afternoon before the temperatures commence to fall; 55° to 65° F. is a suitable range. If the temperature is allowed to rise much above this maximum it makes the plants tender and more liable to injury during a cold snap.

Fresh stable manure should be accumulated for hotbeds and carefully prepared. When it is in a suitable condition a foot or two in the bottom of a glass frame will provide sufficient heat, in moderately warm districts, on which to place seed-boxes for raising tomato and other half-hardy plants for planting outside. In cold districts the usual hotbed, 2 ft. to 3 ft. in height, will be required, and the frame placed on top.

In large establishments the sterilization of the soil for seed-boxes has become a usual practice and much difficulty is avoided in this manner; but fungus troubles sometimes do occur, and in such cases a solution of permanganate of potash is an easy and convenient remedy. A stock solution may be made up, and a small quantity, diluted as required to a pink colour, may be sprayed on the plants from time to time, or they may be watered from a can with a fine rose. The permanganate may be used up to a strength of 1 oz. to 2 oz. of crystals to 4 gallons of water.

Small Fruits.

Strawberries and other small fruits should be given a dressing of such fertilizers as may be required, and shallow cultivations given in bright weather, when the land is dry enough, to destroy weeds. Bordeaux spraying at intervals of two or three weeks will be necessary in most cases to control fungus disease, especially the troublesome leaf-spots of different kinds which are very commonly found in these crops.

Vegetable Crops.

As rising temperatures in spring encourage the growth of weeds as well as crops, the former should be eliminated from the competition before they gain any size. This is best done in bright windy weather, and every opportunity of the kind should be taken. This operation also increases fertility and affords a suitable occasion for working in such dressings of fertilizers as may be required. Not only should growing crops be given this treatment, but it is also an excellent method of completing the preparation of fallow land for planting or sowing.

Spring cabbage, cauliflower, and salad plants generally that have been planted out and are now well established will receive benefit from a dressing of sulphate of ammonia at the rate of 1 oz. to the square yard, repeating the dressing two or three weeks later. Manure also established crops of asparagus and rhubarb; they both have healthy appetites and respond to generous feeding.

Crops of parsnips left in the ground over winter should now be lifted, or a second growth will spoil the flavour. If they are stored in dark, cool, humid conditions they will remain useful for the maximum period. Late-sown carrots should also be lifted so as to avoid splitting.

Towards the end of August in most districts cucumbers may be planted out in heated glasshouses suitable for the purpose. Set the plants deeply and not too firmly in mounds or ridges composed of two parts of good fibrous loam mixed with one part of decomposed stable manure, and a 5 in. pot of

bonedust to every barrow-load of the compost. Let the leader growth run to the top wire before stopping, and stop the lateral growth at the first point beyond the young fruit. When the temperature rises to 90° F. ventilation should be given. As the white rootlets push through the surface of the soil a top-dressing of the above-mentioned compost should be made.

The main crop of parsnips should now be sown, as they require a long season of growth; also melons and cucumbers under glass for planting outside later. Sow also, outside, early carrots, turnip-rooted beet, broad beans, main-crop cabbage and cauliflower, lettuce, early peas, parsley, spinach, and turnips. Sow thinly, and so reduce the work of thinning the young plants later. An amount of 1 oz. or 2 oz. of superphosphate per square yard before sowing, and a light dressing of nitrate of soda after thinning, will suit most of these crops.

Where it is intended to plant out permanent beds of asparagus and rhubarb this should be done now if the land is rich, clean, and deeply cultivated. Without this preparation it is best to defer the planting for another season. For asparagus plantings good selected one-year-old plants are best. They should be set deeply 18 in. to 24 in. apart, with 4 ft. between the rows, when planting large areas. For commercial cropping a moist, sandy, well-drained loam is required. Where small areas are being dealt with the best spacing generally is 18 in. between plants, and between the rows 18 in. and 4 ft. alternatively, thus making beds about 3 ft. wide with alleys between. Early potatoes and artichokes may also be planted.

The Homestead Garden.

Where new lawns are to be sown during the springtime the work is best done during the month of August in most districts. The surface should at least be smooth; in most cases it will need to be carefully graded, for the appearance of a lawn depends very much on doing this well. The level and fall of the surface of the land must be carefully adjusted to suit the position if the lawn is to be quite successful. This demands a great deal of consideration and labour, but once it is accomplished the result is permanent, and the lawn will always be a dominant feature in the garden.

Another important fact at the present time is that the end of the planting season—the time for planting trees and shrubs—is reached with the end of August. It may be continued for a while in districts with a good rainfall, but generally it can only be prolonged at some risk of incurring losses. To avoid this, planting should be completed as soon as possible when the land is sufficiently dry.

In the warmer districts roses should now be pruned. This consists chiefly in thinning out the growth and cutting back what is allowed to remain, so as to admit light and air, also to encourage vigorous growth. As the plants flower on the new wood, this is necessary if good blooms are to be obtained. Pruning may be carried to excess, but more commonly one finds the plants crowded with weak wood and flowers that are consequently not so attractive as they might be. With experience, the art of developing an even well-balanced tree is acquired.

—W. C. Hyde, *Horticulturist*, Wellington.

Lloyd George Raspberry.—Mr. J. D. Kennedy, Orchard Instructor, Auckland, reports: "The Lloyd George evergreen variety of raspberry has recently come under notice. Although raspberries do not usually thrive in the Auckland District, this variety of cane appears to be doing fairly well. It is a fairly strong grower, and has an abundance of well-developed buds and strong foliage, and at present shows every indication of becoming a success. Moreover, so far it has been quite immune from attack of the bud weevil, which is so destructive in raspberry plantations."

CERTIFICATION OF SEED POTATOES.

CROPS PASSED TUBER INSPECTION TO 30TH JUNE, 1932.

FOLLOWING is a list of growers whose crops have been subject to and have passed the tuber inspection in connection with the system of Government certification of seed potatoes conducted by the Department of Agriculture. The list comprises those crops passed up to 30th June. Further lists will be published later.

In the June *Journal* was published a list of growers who had received provisional certificates. The acreage, cropping-power, and percentages of foreign varieties present were given in that list, to which intending purchasers should refer.

Auckland Short-top (N.Z. Sutton's Supreme).

Oakley, W., R.M.D., Halkett.
McPhail, W. A., Mitcham, via Rakaia.
Eder, W., R.M.D., Sefton.
Martin, W. E., R.M.D., Kaiapoi.
Cross, H. E., Sandy Knolls.
Heron, F., R.M.D., Rangiora.
Warren, J., 149 Russley Road, Fendalton.
Carroll, A. D., R.M.D., Southbridge.
Jellie, J., Russley Road, Fendalton. (Line B.)
Petrie, J., jun., Swannanoa. (Line A.)
Sloan, Mrs. M., Lakeside.

Dakota.

McPhail, W. A., Mitcham, via Rakaia. |
Burrowes, J., Mitcham, via Rakaia.

Auckland Tall-top.

Frost, C. H., P.O., Balcairn.

Up-to-date.

Walker, C. E., R.M.D., West Melton.

Epicure.

McLachlan, G., R.M.D., Southbridge.

Majestic.

Robinson, R. G., Box 4, Papanui. (Line A.)

Early Rose.

Weaver, J., R.M.D., Te Pirita.

Robin Adair.

Robinson, R. G., Box 4, Papanui.
Brown, A. F., 92 Woolridge Road, Harewood.

Field Marshal.

Robinson, R. G., Box 4, Papanui.

Great Scot.

Robinson, R. G., Box 4, Papanui.

Early Regent Bolter.

Oakley, W., R.M.D., Halkett.

Arran Banner.

McNae, F., R.M.D., Courtenay.

—*Fields Division.*

Orchard Pest declared.—The insect *Cydia (Carpocapsa) salitans*, popularly known as the Mexican jumping bean, has been declared a disease under the Orchard and Garden Diseases Act, and any importations of fruit or plants found to be infested with it are now liable to be destroyed at port of arrival in New Zealand.

Crimson Cox's Orange Apple.—Mr. J. H. Thorp, Orchard Instructor, Nelson, reports as follows: "Six small trees of this variety were received from England and planted at Nelson for testing in March, 1930. During the past season a small number of fruits were borne on the trees, some of which were picked and forwarded to Wellington at three different dates, covering a period of four weeks, coinciding with the picking of the ordinary Cox's Orange. The maturing period appears to be the same as local Cox's, and the tree and fruit have similar characteristics. The fruit, though carrying more suffused colour than the Cox's Orange, cannot be said to be exactly crimson, the redness being of a dull nature. As the fruit ripens the apple takes on a very yellow appearance, which, mingling with the red, gives rather a pleasing appearance. The flavour and texture do not appear to be quite equal to the Cox's, but this may improve with age of tree. Until this variety is further studied it is not advisable to recommend growers to take any action regarding its propagation."

WEATHER RECORDS: JUNE, 1932.

Dominion Meteorological Office.

THE reports received from different districts regarding the weather in June vary markedly according to whether or not they were exposed to the westerly winds which prevailed during the latter half of the month. Temperatures were actually below normal everywhere except in the southern half of the South Island, but in the Poverty Bay and Hawke's Bay districts, in Marlborough, North Canterbury, and parts of the interior of South Canterbury and Otago, the dry, sunny weather and absence of wind gave an impression of mildness. On the other hand, in the central and western portions of the North Island a series of severe frosts in the first half of the month was followed by a period of dull, wet, and boisterous weather. On the west coast of the South Island, though rainfall was somewhat above normal, conditions were rather better. Similarly, in Southland the weather was very dull and the rain much above the average, but the mean temperature was about normal for June, and there were no severe cold snaps or heavy snowfalls.

Rainfall was above normal in the western districts of both Islands and also in Southland. In the latter district and in the South Taranaki Bight the excesses were heavy. Much the greater part of the rest of the country had less than half the average for June.

Temperature.—As already intimated, mean temperatures were for the most part below normal. The departures were, however, seldom large, and over the southern half of the South Island the normal was exceeded slightly. Several falls of snow occurred on the high levels and the ranges now have a thick coating. In the low country there were no falls of any importance. Frosts were very numerous and frequently severe. The interior of the North Island, especially the Waikato district, experienced unusually heavy frosts in the first half of the month.

Sunshine.—In Taranaki and Western Wellington, and in the southern half of the South Island, less than the average sunshine was recorded. At Invercargill the total duration was only 52.5 hours. Elsewhere, the totals were considerably above the June average.

Wind.—Westerly and south-westerly winds prevailed, especially during the latter half of the month. Above Foveaux Strait, and in Taranaki and the South Taranaki Bight, they were frequently boisterous.

Thunderstorms were unusually frequent and severe, particularly in districts with a westerly aspect.

Pressure Systems.—The first important storm occurred between the 4th and the 7th. This was a cyclonic depression which developed in the Tasman Sea, the centre crossing Otago on the 5th. Rain was almost general, and some severe thunderstorms were reported. On this same night there were extensive snowfalls on the ranges of both Islands.

The period from the 15th to the 28th was very disturbed. A series of depressions passed, the majority being of the westerly type. Showers or heavy rain were experienced every day in western and far southern districts. Thunder and hail storms were also of frequent occurrence. The Manawatu and neighbouring rivers were in flood for several days. Between the 16th and 18th some of the Southland rivers also were flooded. The heaviest and most widespread rain occurred on the 16th and 17th, when a cyclone again crossed Otago. Small tornadoes were experienced respectively at Whakatane on the night of the 16th and at Marton on the evening of the 25th. Eastern districts did not fare badly during the greater part of this time, but on the 28th a strong southerly set in and a bitterly cold day was experienced throughout the country. Precipitation was almost general. Snow fell on the high levels of both Islands, and

reached the low levels, but only in small quantities, in eastern and southern parts of the South Island. During the period here referred to barometers remained unusually low. On the 17th many places recorded pressures below 29 inches. From the 29th the weather began to improve.

RAINFALL FOR JUNE, 1932, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average June Rainfall.
<i>North Island.</i>				
	Inches.		Inches.	Inches.
Kaitaia	3.14	13	0.90	6.82
Russell	4.24	14	1.32	6.66
Whangarei	3.74	15	0.70	6.67
Auckland	4.07	19	0.70	4.95
Hamilton	6.57	18	1.62	5.06
Rotorua	5.23	14	1.75	5.23
Kawhia	..	..	..	5.63
New Plymouth	6.16	18	1.08	5.98
Riversdale, Inglewood	9.32	19	1.56	10.29
Whangamomona	9.95	17	1.88	7.81
Eltham	6.12	15	2.25	5.71
Tairua	5.12	14	1.70	7.07
Tauranga	4.95	14	1.44	5.42
Maraehako Station, Opotiki	4.37	12	1.54	5.74
Gisborne	1.09	8	0.81	4.97
Taupo	6.21	15	1.82	4.50
Napier	0.45	7	0.23	3.51
Hastings	0.72	8	0.30	3.18
Taihape	4.29	21	0.54	3.43
Masterton	2.69	17	0.55	3.71
Patea	5.25	17	0.78	4.20
Wanganui	4.72	17	1.39	3.33
Foxton	4.62	13	1.12	3.28
Wellington	2.18	14	0.58	4.19
<i>South Island.</i>				
Westport	11.48	18	1.26	8.85
Greymouth	9.15	18	1.00	8.74
Hokitika	10.25	18	1.32	9.30
Ross	9.28	15	1.45	8.70
Arthur's Pass	10.34	11	2.80	10.54
Okuru	11.85	15	1.95	10.67
Collingwood	10.72	16	2.85	10.28
Nelson	2.93	14	1.22	3.54
Spring Creek	1.82	11	0.90	2.99
Hanmer Springs	1.48	11	0.50	3.56
Highfield, Waiau	1.07	6	0.36	2.50
Gore Bay	0.83	9	0.18	2.80
Christchurch	1.15	12	0.28	2.68
Timaru	0.56	4	0.43	1.75
Lambrook Station, Fairlie	0.39	3	0.31	1.90
Benmore Station, Clearburn	0.70	8	0.25	1.85
Oamaru	0.56	8	0.34	2.01
Queenstown	0.91	7	0.53	2.32
Clyde	0.39	5	0.19	0.93
Dunedin	2.85	22	0.43	3.16
Wendon	3.96	16	1.11	2.50
Gore	5.15	23	1.28	2.83
Invercargill	7.06	26	0.94	3.63
Puysegur Point	8.70	27	1.53	6.47
Half-moon Bay	6.92	23	1.35	4.79

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

LICK FOR DAIRY COWS.

"CATTLE LICK," Marton :—

Recently I made a lick for dairy cows of the following materials: 28 lb. coarse salt, 20 lb. air-slaked lime, 50 lb. bone-flour, 2 lb. sulphate iron, and 3 oz. potassium iodide. Could you suggest an improvement on this mixture, and also how to treat it to stop it from being blown away by the wind, for even if it is put in a covered container it will be affected by the wind? The air-slaked lime is very light, and it has occurred to me that perhaps it would be better to replace the 20 lb. of lime with a similar amount of salt and put lime in the drinking-water.

The Live-stock Division :—

The following lick is suggested as being suitable for your district. Containing more salt and omitting the air-slaked lime, this lick should be more suitable for use in covered containers. Add 50 lb. salt to 50 lb. bone-flour. These two are thoroughly mixed together and sprayed with a solution containing $\frac{1}{4}$ oz. potassium iodide dissolved in a small quantity of water. Iron is not necessary in the Marton district. If it is desired to supplement this lick by increasing the available phosphates, 1 lb. of superphosphate may be added to 100 gallons of the drinking-water.

GROWING TIMOTHY FOR SEED CROP.

"MATAURA," Waikoikoi :—

Kindly let me know how many pounds of timothy is required to sow down a paddock for harvesting for seed; and would it be ready to harvest the year after sowing, or would it take longer?

The Fields Division :—

It is customary to sow 15 lb. of timothy seed per acre when sowing alone. Ordinarily, timothy sown in the autumn would be ready to harvest the following January, but if spring-sown—for example in 1932—it would not be ready for harvesting until January, 1934, unless favoured by exceptional circumstances. A good average yield should be in the vicinity of 500 lb. per acre.

FOWLS WITH FOOT TROUBLE.

"AMATEUR," Athol, Southland :—

For some time past first one of my hens then another has become lame and gradually grown worse, until it either had to be killed or died. A lump seems to form under the foot, and causes the trouble so far as I can see. As all are young birds, I would be greatly obliged if you could advise what is wrong, and, if possible, suggest a remedy.

The Live-stock Division :—

Judging from your remarks it may be taken for granted that no form of disease is present, but that the birds referred to suffered from corns. The most common cause of corns is abnormal pressure on the feet such as is caused by the birds flying down from a high perch to a hard floor, or in being compelled to exercise on hard or stony runs. We have, however, seen many cases of the kind brought about by a prick from a thorn, &c., when the birds are on a free range, or when thistles or pieces of gorse have been among the litter used in the house. Your only safe course, therefore, is to endeavour to find the cause and remove it. The perches should not be higher than 18 in. from the floor of the house,

and the floor should be covered with straw or similar material to provide a soft place for the birds to land when leaving the perches. For treatment we would advise painting the affected feet with iodine, say, every other day. The feet may also be successfully treated with a bluestone solution. Dissolve a piece of bluestone about the size of a walnut in $\frac{1}{2}$ pint of hot water, and when the solution is cool dip the affected foot into it. An affected bird should not be allowed to perch, care being taken that she is provided with soft bedding.

STRAWBERRY-PLANTS DESTROYED BY GRASS-GRUB.

M. M., Hastings :—

All my last year's strawberry-plants are practically destroyed by the grass-grub. Would carbon bisulphide be of use if applied, say, 8 in. deep, at intervals of 2 ft.? And what month would be best to apply it?

The Horticulture Division :—

If the soil is light this pest can do great damage to a plantation of strawberries, and in the drier districts it is often impossible to grow them in land of that kind. So far, fumigants have not been of great practical assistance under those conditions. The carbon bisulphide you suggest would certainly kill the larvæ, but would also most likely injure the plants if used to the extent necessary to kill the pest. Some very interesting experiments in this regard were carried out by the Orchard Instructor for the Hawke's Bay district last season, and you could not do better than discuss the problem with him, as all the circumstances could then be considered.

CREAM OF HONEY.

"APIARY," Rotorua :—

We recently purchased some honey from a local store, which has granulated, but is very soft and smooth, being almost semi-liquid. It is labelled "Creme Whipt Honey," and the label states that the contents are a specially prepared honey which will always keep soft and creamy. Can you tell me how to treat honey to make it like this?

The Horticulture Division :—

The article you refer to is produced by processing honey that has granulated solid. The processing breaks up the arrangement of the crystals, and the product is soft and creamy. A superior product can be made by grinding granulated honey in a meal or flour grinder, providing the adjustment and the speed of the machine are right. The cream of honey may be run direct into tins or glass containers. Ordinary room temperature will not affect it.

LAMPAS IN HORSES.

"LAMPAS," Eltham :—

Will you tell me the best treatment for a horse with lampas?

The Live-stock Division :—

Lampas in horses is a term applied to congestion and swelling of the mucous membrane of the hard palate of the mouth, especially behind the incisor teeth. It is a minor affection associated in the young horse with the process of dentition, and in aged animals with digestive disturbance. In the former instance, favourable results are obtained by giving a few bran mashes at intervals, to which has been added from 1 oz. to 2 oz. of Glauber salts. If there is any difficulty in mastication, oats may be crushed for a few weeks. Lancing of the gums is not recommended, as there is a danger of wounding the palatine arteries. The use of the cautery or firing is positively barbarous, and should not be allowed. The condition is only a temporary one in young horses. When associated with digestive disturbance in aged horses, attention should be paid to the molar teeth. All irregularities should be removed to ensure thorough mastication of the food. Here, again, bran mashes should be given to which salts and baking-soda have been added in $\frac{1}{2}$ oz. doses. Undue importance is often attached to the condition known as lampas, whereas in reality the trouble is invariably due to the teeth.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 19th May to 30th June, 1932, include the following of agricultural interest:—

No. 65952: Packhorse manure and seed distributor; R. B. D. Walker. No. 68096: Tine harrow; J. E. Jeffs. No. 68207: Wire-strainer; R. H. Logan. No. 68385: Tractor; J. Donaldson. No. 67053: Dressing-apparatus of clover-shellers; W. L. Donald. No. 67137: Manure distributor; D. A. Dunn. No. 67141: Separating and collecting fruit juices and pulp; F. R. Shirtcliff. No. 67176: Milking-machine; C. A. Martin. No. 67283: Hay and ensilage knife; I. A. Smith. No. 67638: Extraction of vegetable fibre; E. V. Hayes-Gratze. No. 68352: Machine for scouring wool; E. V. Hayes-Gratze. No. 68523: Tractor-wheel; A. Charter. No. 66693: Seed-blocks; International Skogplantingsmetode Aktieselskap. No. 67365: Teat-cup; A. J. Lickfold. No. 67456: Milk-claw; G. R. Terry. No. 67524: Cheese; A. T. Ross. No. 67548: Determining the fat-plus-casein content of milk; G. M. Moir. No. 67607: Wiring cheese-crates; D. A. Dunn. No. 68769: Milking-machine claw; International Harvester Co. of N.Z., Ltd.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

BOOKS RECEIVED.

- GROWTH AND THE DEVELOPMENT OF MUTTON QUALITIES IN THE SHEEP: A SURVEY OF THE PROBLEMS INVOLVED IN MUTTON PRODUCTION. By John Hammond, Institute of Animal Nutrition, School of Agriculture, University of Cambridge, 597 pages, with illustrations. Oliver and Boyd, Edinburgh and London. 42s. net.
- AGRICULTURE: A TEXT BOOK FOR NEW ZEALAND SCHOOLS AND COLLEGES. By R. P. Connell, Fields Division, Department of Agriculture, and J. W. Hadfield, Agronomist, Plant Research Station, Palmerston North. Fourth edition, revised and enlarged. Whitcombe and Tombs, Ltd., Wellington, &c. 6s. 6d.
- A MANUAL OF BEEKEEPING FOR ENGLISH-SPEAKING BEEKEEPERS. By E. B. Wedmore. Edwin Arnold and Co., London. 15s. net.
- PASTURE PLANTS AND PASTURES OF NEW ZEALAND. By F. W. Hilgendorf, Canterbury Agricultural College, Lincoln. Third edition, revised. Whitcombe and Tombs, Ltd., Wellington, &c. 2s. 6d.
- FRUIT TREE AND GRAPE VINE PRUNING. By George Quinn, Chief Horticultural Instructor, Department of Agriculture, South Australia. Robertson and Mullens, Ltd., Melbourne. 5s.
- THE MARKETING OF RABBIT FLESH. By W. King Wilson, Rabbit Specialist, Harper Adams Agricultural College. Watmoughs Ltd., Bradford and London. 1s. 6d.
- THE MAINTENANCE OF SOIL FERTILITY: FACTS AND FIGURES ON THE USE OF FERTILIZERS. Kempthorne, Prosser, and Co., Ltd., Dunedin, &c.

Corky Pit of Apples.—Referring to this trouble, Mr. M. Davey, Orchard Instructor, Mapua, remarks: "Corky pit has been of serious economic importance in the Nelson district during the past season, and in the absence of direct evidence I am inclined to consider that deep cultivation with heavy disks is aggravating if not creating a great deal of the trouble. It is reasonable to suppose that the cutting of large numbers of the surface roots must not only disturb the normal balance of the tree, but will also deprive the tree of nutriment at a period in which it is most essential. The fact that trees on the ridges, which in most instances are found to be largely surface-rooting, are the worst sufferers seems to strengthen this contention."